By

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HOW TO KEEP WELL

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CONTENTS.

HOW TO KEEP WELL.

CHAPTER I.

THE NEED FOR FRESH AIR.

Good health is one of the greatest blessings we can enjoy. When we are in perfect health, we can discharge the duties of life much more easily and effectively than when we are not. Without good health, we cannot have that vigour of body and of mind necessary for the putting forth of our best efforts.

It should be our aim, therefore, to be as healthy as possible, but to attain this end it is necessary that we should observe certain rules founded upon a knowledge of the constitution of our bodies. For example, if we know that to breathe impure air is a cause of disease, we must avoid a bad atmosphere. If it is shown that the drinking of impure water causes illness, we must take care that all the water we drink is wholesome. Similarly, if we know that certain foods are not healthy, or do not agree with us, we must take care to avoid them. We should equally

avoid a house which is not healthy, which has not sufficient light and air around it, and from which dirt and refuse of all kinds are not speedily and regularly removed.

If we wish to obtain a good example of the necessity for observing the laws of health in order that we may be well, we may find it in the need for fresh air. When we are at rest we breathe about sixteen or seventeen times every minute. We can see our chests rising and falling—rising in the act of expanding to take air into our lungs, which are contained in the chest, and falling in order that air may be sent out from the lungs. This action takes place so long as life lasts, and any interference with the act of breathing, if it were maintained for even a few minutes, would cause death. We see such a result in the case of a man who, unable to swim, falls into deep water. Unless he is pulled out within a very few minutes, he dies from suffocation.

Precisely the same thing might happen in the case of a man going down a well in order to clean it. In deep wells, and also in mines, we find a gas called carbon dioxide, or, in popular language, carbonic acid gas. The presence of this gas in more than a certain proportion is absolutely fatal to life. In order to test the state of the air in the

well, the man who has to go down ties a candle to the end of a long piece of string. He lowers this candle beneath him and watches its flame. If the air of the well is fit to breathe, the candle will continue to burn, because, as we shall see later on, the oxygen gas of the atmosphere, which is required to make anything burn, and to support life, is present in the air of the well. On the other hand, if the man sees the flame of the candle snuffed out as by some unseen hand, he knows that carbonic acid gas is present, and that where the candle will not burn it is not safe for a human being to go. Oxygen gas, the more important of the two elements, oxygen and nitrogen, of which the air is composed, is as necessary for the maintenance of life as for the maintenance of burning; while carbonic acid gas will support neither the one nor the other.

We have all felt the effects of bad air under various circumstances. If we sit with a number of others in a room with the windows closed, the door shut, and the gas-lights burning, we soon begin to feel dull, heavy, and sleepy. But if this room be ventilated—that is, if fresh air be admitted to it—or if we pass from it into the open air, or into another room which has not been occupied, these dull feelings soon leave us. The reason of all this is, that

instead of breathing pure air, we have been taking into our lungs a quantity of injurious substances, amongst them carbonic acid gas. This gas has come largely from our own lungs. It is, in fact, part of the waste matter of our bodies.

If we inquire why the human body should give out any waste at all, we find the answer to this question in what the man of science tells us—namely, that our bodies are machines that are always working. All work, whether it is in a steam-engine or in a human body, is attended with waste. If there is much work done, there will be much waste. If there is little work, the waste will, on the other hand, be small. Carbonic acid gas, then, represents part of the waste matter given off from our bodies. In one sense it might be compared to the ashes of a fire going on within the body, for all throughout life there is a process of burning, whereby the bodily heat is maintained.

Let us go back for a moment to the hot and stuffy room which has already been described. In addition to the air being rendered impure through the carbonic acid gas and other waste matters given off from the lungs, we have also to take into account the effect of the lights burning in the room. Now, whether these lights consist of gas-jets, lamps,

or candles, they also are giving forth carbonic acid gas and other waste matters. An ordinary gas-jet gives off at least as much carbonic acid gas and heat as come from the lungs of two human beings; thus not only helping to make the air impure, but also hotter than it should be.

The headache and the dull feelings which we get from breathing impure air are explained in a very simple way. We must remember that the air we breathe into our lungs passes into the blood, just as the carbonic acid gas and other waste matters, which are given off from the lungs, have really come from the blood. In order to be healthy, our blood must be supplied with oxygen gas obtained from the air. Where the air is impure, we cannot get the proper amount of oxygen necessary to keep us in health. If, therefore, we rebreathe our own breaths, and thus inhale the carbonic acid gas and other waste products given out from our own bodies and from the lights in the room, these things, passing into the blood, are carried to the brain.

Now, the important parts of our brain consist of wonderful microscopic objects called brain-cells. These are really living things, and form the active population of the brain. They are the 'brain workmen,' who perform all the duties which the brain has to do. If they do

not receive their proper quantity of oxygen, but are supplied instead with carbonic acid gas, they are really being poisoned, and are rendered unfit for the discharge of their duties. We can now understand why it is that when we leave the hot, stuffy room in which our brain-cells have been poisoned with carbonic acid gas, rendering them dull and stupid, and unable to perform their work properly, and pass into a pure atmosphere, our brain-cells recover themselves. They are supplied with oxygen, and once more are able to discharge their duties perfectly.

A large part of our life is spent in sleep. We may, in fact, say that one-third of our existence is devoted to rest and repose, so as to fit us for resuming our daily work. It is very important, therefore, that our bedrooms, of all rooms in the house, should be well ventilated. When we go to sleep we are at the mercy of whatever air our sleeping apartment contains. When we are awake, if we feel the atmosphere to be hot and stuffy, we can put up the windows, or remove from one room to another, in order to secure a supply of fresh air. It is very different when we go to bed. It is then impossible for us in our sleeping state to move out of the atmosphere in which we are resting. We have all experienced the feeling of rising

in the morning somewhat tired, although we have apparently slept soundly during the whole night. This tired feeling is another result of our breathing impure air during the hours of sleep. Owing to the want of pure air in our bedrooms, our sleep does not do us the good it ought in furnishing us with the vigour needed for the duties of another day.

In India, in the year 1756, one hundred and forty-six British subjects were imprisoned by order of an Indian ruler in a room measuring about 18 feet square, and lighted only by two small windows. The door of the prison was, of course, closed, and the windows formed the only openings by which fresh air could be admitted. These unfortunate people were confined in this place, since known as 'The Black Hole of Calcutta,' for the space of a night. Very terrible accounts were written of their sufferings, due in the first place to the fact that they were compelled to rebreathe their own breath and that of their neighbours, while their bodies were hungering and crying out for fresh air. As a result, when the door was opened, one hundred and twenty-three out of the one hundred and forty-six persons were found to be dead. There were thus twenty-three alive, but of these, several perished afterwards as a result of the terrible experiences

they had undergone. These people died from poisoning by bad air, and therefore perished from that form of death which we term 'suffocation.'

Another case similar to the 'Black Hole of Calcutta' was that of the steamship *Londonderry*, sailing from Ireland to Glasgow. On the night of the 1st of December 1848, the deck passengers were ordered to go below on account of a very severe storm which arose. They were crowded into a cabin far too small to accommodate them. In order to prevent their return to the deck, the hatches were closed down. Out of one hundred and thirty persons confined in this small space, seventy were suffocated before the morning dawned.

Air is thus seen to be an absolute necessity, not merely for the maintenance of health, but in order that life itself may continue. In the course of a subsequent lesson we shall deal with the means to be adopted for getting rid of foul air, and for introducing a supply of fresh air into our rooms. Meanwhile we should keep in mind what we have just learned—namely, that pure air is one of the necessities of life. We require, to keep us healthy, fresh air, wholesome food, pure water, and clean dwellings; and of these our most constant need is pure air, seeing that

if our air-supply is withdrawn from us, even for a very short space of time, death must result.

CHAPTER II.

CLEANLINESS AND HEALTH.

THERE is an old saying that 'cleanliness is next to godliness.' This proverb came originally from the Koran, which is the Bible of the Mohammedan faith. John Wesley, the founder of Methodism, also used it, and it is therefore often attributed to him. There can be no doubt that the proverb is very true. We do not look upon a dirty person as a human being who lives properly, nor do we think of a dirty house as 'Home, Sweet Home' from a health point of view.

It is an undoubted fact that health is largely a matter of cleanliness. Let us think of this point for a few moments. We have seen that cleanliness of the air we breathe is a necessity for healthy life. In order to live healthily, we also require to eat clean foods and to drink pure water. The house must also be clean. It must not have any collection of dirt or filth left around it, and the drains must be flushed so as to be clean, and to

carry right away the waste matters which pass into them.

Again, most diseases are caused by what we may term 'dirt.' Under this head we include not merely dirt itself, but also the germs which are the cause of many of the diseases, such as fevers, that are responsible for so many deaths every year. A great secret of healthy living, therefore, is the getting rid of 'dirt,' which a great man once described as 'matter in the wrong place.' It has been proved that ordinary dust contains a large number of germs capable of giving rise to disease, and even where no disease is produced by such microscopic living things, which are really low forms of plant-life, they may have the effect of spoiling our foods, and in some cases of rendering them dangerous to eat.

It is a matter of great importance to keep the skin clean. For this purpose we should wash ourselves regularly, and take a hot bath at least once a week, using soap for the purpose of cleansing away the dirt particles which adhere to our bodies. When we fail to keep ourselves clean, we are not merely liable to the attack of certain diseases, but we ourselves become aware of our uncleanliness from the disagreeable odour given off from our clothes and from our bodies. We know when the air itself is not clean by the stuffy odour it

gives off. This smell disappears when the windows are opened and fresh air comes into the room.

A man of science once described the air as consisting of a 'stirabout' of minute particles. He threw a beam of electric light across the air of a room. Where the air was pure, the course of the beam was uninterrupted; but wherever any floating matter or dust was present the beam of light became blackened. We do not, however, require an electric light to show us that the air, which in ordinary daylight we think so clear from all dust, is really full of floating particles. You have all walked into a dark room, the windows of which were closed, and noted a beam of sunlight passing in through a chink in the shutter. The beam of light reveals countless motes and atoms dancing in its track. If now we open the shutters, our eyes cannot perceive these motes in the air. They are nevertheless present in the air everywhere, with perhaps the exception of the air over the open sea and that high up on the mountains. This is the reason why sea air and mountain air are the most healthy to breathe, because they are most free from dust particles, and are therefore the purest.

The purity of the air on the mountains may be proved in the following way. If we open a jar containing meat or soup, and allow

it to remain exposed for some days in the house, the contents of the jar will decay and putrefy; but if the same jar were opened high up on a mountain, the meat or soup would not decay, but would remain sweet for many days. This is because there are few or no germs in the mountain air, while in that of our houses there are many germs, and these falling into the jar set agoing the work of decay.

The floating dust of the air may in one way be described as 'dirt,' and it would be a very admirable thing if we could escape from its influence; but in towns and cities, and wherever we have human beings collected together, it seems to be impossible to avoid its presence. Much of the dust of the air consists of particles of mineral matter and of shreds and fragments of clothing. We can also detect in the air-dust fragments of our bodies in the shape of the little worn-out particles or 'cells' which are perpetually given off from our skin. But a certain proportion of the air-dust consists of the microscopic living things we call 'germs' or 'microbes.' Some of these germs, when we take them into our bodies, are capable of producing disease. Others are harmless to us, but show themselves in the shape of the growths they produce on foods and other substances.

Suppose, for example, that a piece of cheese has been put away in a cupboard in a fairly warm room, and has been covered over for some days in a cheese-dish. When it is looked at it will be found to be covered more or less completely with a bluish-white growth which we call 'mould.' In olden days, people believed that the mould grew out of the cheese itself, by reason of the badness or decay of the cheese. We know now that cheese has no power whatever to produce a mould-plant, and we have been able to trace where moulds come from, growing as they do, not upon cheese only, but also upon the surface of apples, jam, and even upon damp boots which have been put away in a cupboard or other place.

Mould is a living plant of a low kind. If we look at it under a magnifying-glass, we find that it consists of a number of fine threads which resemble roots, and of little stalks rising from these roots. At the top of the stalks are very fine rounded specks, which are the 'spores' or seeds of the mould. These spores, on the slightest disturbance of the plant, are given off to the air. When they settle down upon another piece of cheese they produce another mould; so that we see clearly where our first mould came from. The cheese formed a kind of soil, the spores of the mould being the seeds, and so we are taught that

every living thing must have sprung from a living parent.

We also learn the lesson that the air is a great sea in which these seeds float, ready when the chance is offered to them of springing up into the various forms of life they represent. Naturally more dust is found in the air of towns and cities than in the air of the country. The sea air or that of the mountain, as we have already seen, is almost entirely free from germs. It is of great importance, therefore, that in towns and cities large open spaces should be provided so as to give a free circulation of the air, and to limit in this way the amount of dust it contains.

When the air is still, its dust settles in every part of a room or apartment. It is necessary, therefore, as part of our duty in keeping our house clean, to remove this dust. There is no part of a room in which dust will not settle. We can see it collecting on articles of furniture and other objects, from which it can be removed by dusting. But we must remember, also, that dust accumulates on the floor, on the walls, and on the roof. Where cornices exist, these always hold a large number of dust particles. It would be better if in our houses, as in many hospitals to-day, we had no corners—that is, as corners are ordinarily made. The best way of avoiding

the collection of dust, and of effecting its easy removal, is to make all the corners rounded, so that they can be cleaned easily.

In sweeping a room, and more especially in cleaning a carpet, it is customary to use damp tea-leaves or water in order to prevent the dust from rising into the air. This is no doubt a useful enough plan. In dry sweeping, the dust is simply swept into a pan, in which case it should be burned directly, so as to get rid of it easily and to prevent its getting into the air again.

Fortunately for us, the winds, causing movement of the air, not merely mix its gases thoroughly, and thus keep the proper amount of oxygen gas present, but they also sweep away a large amount of air-dust. The rain also carries away many of the dust particles of the atmosphere. After a shower of rain, not merely is the air purer, but even the earth itself is refreshed; and if we look at a gutter after a rain shower we can form some notion of the large quantity of dirt which is removed from the earth's surface and carried down into the sewers, and from them sent, perhaps, into the sea. Notwithstanding these natural ways and means of removing dust and dirt from our neighbourhood, we require to keep an ever-watchful eye upon our homes. It is obvious that what happens outside in the way of purifying the

air and the earth by means of wind and rain cannot operate in our dwellings. There is great need for the exercise of personal attention to our dwellings, and for our being ever on the watch to exercise care regarding their cleanliness.

In our houses, the process of cleaning and the getting rid of dust and dirt should be regularly carried out. Daily dusting is required to keep the home healthy. At various other periods, however, there takes place a general turn-up of the house, such as a 'spring cleaning.' This process is intended to be of a more thorough character than the daily cleansing, and has for its aim chiefly the rubbing down of the walls and the cleaning of the carpets. It is very desirable that this cleaning should be carried out more than once a year, seeing that the accumulation of dust in a year's time must be very large.

It would be well in all our houses if we adopted the plan, seen in many dwellings, of having the carpet placed in the middle of the room only. The sides of the room may be covered by linoleum or waxcloth, or they may simply be stained. The advantage of this plan is that it does away with the need for lifting heavy furniture so as to allow the carpet to be drawn from beneath, and the room is therefore not merely cleaned more quickly, but

also more effectually. Carpets themselves are great harbourers of dust, and attention must be paid to their thorough cleaning, either by beating them well or by cleaning processes carried out by steam or other means.

With regard to the ordinary cleaning of a room, which should be done, say, once a week, the whole of the furniture should be taken out and well dusted. If there is any paint-work in the room, this should also be well dusted, and at the cleaning season should be thoroughly washed down. The best soaps for this purpose are those which, like carbolic soap, contain a disinfectant—that is, a germ-destroying substance. The floor should also be treated in the same way, in order that it may form a clean foundation on which the purified carpet may be laid.

Another source of dirt in the house is the smoke arising from ordinary lights. We all know how, when a gas-jet has burned for some time, the ceiling becomes blackened. It is very much the same with lamps, because a certain amount of unburnt substance is given off in the form of black particles formed of carbon, and constituting what we call 'smoke.' When such particles accumulate in a chimney we term them 'soot,' and we see here the reason for having the chimneys swept in order that the fire below may draw properly, and

that we may run no risk of the soot in the chimney being set on fire. Unless soot represented unconsumed coal, it would not, of course, be capable of burning.

We have seen that large quantities of the dust of our houses are apt to remain in cornices near the ceiling. These parts should be specially attended to in cleaning, as should also the walls themselves. Experiments have shown us that in the case of people suffering from certain diseases, the germs of these diseases, passing from the body, are apt to mingle with the dust of the house, and to stick to the walls, and especially to cornices. The whole work of house-cleaning, we thus see, is one of great importance, and has a great influence on the health of the inmates. From the roof to the floor, each room may be said to represent a house in itself. If, therefore, cleanliness of every room be ensured, we can understand how the house will become a 'sweet home' in the health sense of that saying.

Every one knows that houses, as they are ordinarily built, have leading from them certain pipes, which are known by the name of 'drains.' As a rule, drains are buried in the ground, and are used to carry away all waste matters. The kitchen sink may afford a very good example of what we mean by a drainage system. The sink receives the waste water

which has been used in washing dishes and other things. The water runs away from the sink into a pipe which is known as the 'waste-pipe.' This pipe disappears into the ground, and if we dug up the earth and followed the pipe we should soon find it joining a larger pipe, into which drains from other parts of the house empty themselves. These other drains bring the waste water from baths and other places. Suppose, now, that we traced this larger drain as it passes away from the house, we should discover that it ended in and joined a much larger pipe laid in the street. This big pipe we call a 'sewer,' and if we had the power of following the sewer we should find that in its turn it would unite with large drains from other streets, and would finally end in some place or other where the whole waste matters of a town (or, as we call them, 'sewage') are deposited. This is a simple sketch of what is called a sewage system. As the larger part of the waste matter consists of water which has been used, we call such a system a 'water-carriage system.'

The sewage of towns is got rid of in various ways. Sometimes it is run into the sea. In other cases it may pass into a river. We can all understand that if the water of this river is used for drinking purposes, it

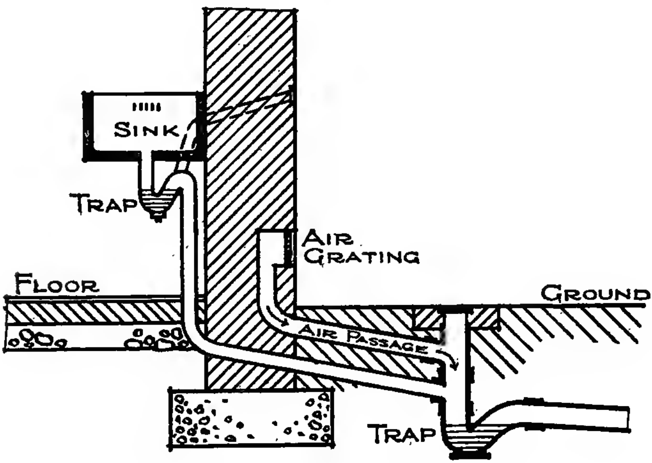
is apt to carry disease to those who drink it, for it has been rendered impure and poisonous by the sewage poured into it. In many towns, therefore, the sewage is discharged into special pits or tanks in which, by the action of certain germs falling into it from the air, it is converted into what is practically pure water, and this water can then be discharged into a river or lake without fear of causing disease.

The cleanliness of our house depends on the perfect removal from it by drains of what we may call 'dirt' of another kind than dust. No house can be healthy if the waste matter is not properly carried away. Sometimes in country places there are no drains to be found in connection with houses; but other means exist for disposing of the waste, and one of the most common plans is that of running the waste matters into a large pit called a 'cesspool.' It is necessary that this cesspool should be frequently cleaned out, in order that it may not overflow and cause illness in the neighbourhood.

We might ask ourselves what is likely to happen to us if we live in houses where the drains have not been properly made. The answer to this question is that we run the risk of being made ill from the attack of various diseases. This is simply another example of the danger we run when 'dirt' of

any kind is allowed to accumulate in or near our houses.

The only safe house to live in is one in which the drains of the dwelling are separated in a particular way from the sewer. Let us go back for a moment to the kitchen sink. Sup-



Waste-Pipe from Kitchen Sink.

pose that the waste-pipe which carries away the water of the sink ran straight down into the drain. The gases of the sewer would pass up the waste-pipe, and come in this way into the kitchen. Now, these gases are injurious to health, and if we breathe them we are running great risk of being made ill. The

waste-pipe of the sink, instead of going straight down to join the drain, should be made to let the waste water escape into what is called a 'trap.' A trap is simply a U-shaped bend in the pipe, which, from its form, always remains full of water. This water absorbs the foul gases rising from the sewer, thus 'trapping' them, and preventing them from passing up the waste-pipe into the kitchen. Just at the place where the waste-pipe enters the drain, there should be another trap as an additional security. Between this trap and the house, too, there should be an opening for the admission of fresh air, so that when waste water is not passing down the pipe, fresh air is passing up it.

This is the manner in which all drains require to be treated in order that the house they belong to may be safe and healthy to dwell in. If any drain is not constructed with a trap at the end, so as to prevent the back-flow of gases, then the kitchen or other place from which such a drain passes may very well be regarded as really a part of the sewer itself.

We have seen that pure water is one of the things necessary to keep us in good health. Most of us do not think of water as a food, and a still greater number of persons do not think of the air they breathe as being part of the food they require. Later on, you will

be taught the reason why air may be regarded as a highly important part of our diet. Water may be said to rank next in importance to air, for the reason that whilst life ends in a very few minutes if we are deprived of air, it is also impossible to sustain life for any long time without water. If a man were to be deprived of all solid food and water, he would probably die in about a week. If, however, we allowed him to have water alone, his life would be prolonged for twenty, thirty, or even forty days. Of course, it will be understood we are allowing him at the same time to breathe air.

Now, why is it that life can be supported on water for such a long time? We must not think, of course, that if a man lived for thirty days on water alone, his body would be well nourished at the end of that time. On the contrary, not having had any solid food, he would appear very thin and miserable, and he might die very shortly if solid food were to be longer withheld from him. The answer to the question, however, why water alone can keep the body going for a long time, is found in a very interesting fact. If we gave a human body to a chemist and asked him to analyse it, he would tell us that two-thirds of its weight consisted of water. Suppose the body of a man to weigh 165 pounds, we should find

that 110 pounds of his weight would be water, the remaining 55 pounds representing the solid parts of his frame.

The first thing we have, therefore, found out about water in its relation to the body, is that it is one of the most important substances of which the body is built. But there are other reasons why water is of great importance. It is required in every action the body performs; for example, it is needed to dissolve food in the act of digestion. Moreover, the water-supply of the body is always being used up in the performance of our bodily actions, and water is also continually leaving the body in the shape of waste given off by the lungs and the skin, whilst the kidneys are also organs that filter out so much water from our blood. So we come to the conclusions, first, that water is part and parcel of our body, and is found in the composition of every organ from bone to brain; and, second, that a full supply of water is necessary in order to replace that which the body is perpetually parting with.

We can now understand why thirst is so much more difficult to bear than hunger. If you have read accounts of the great pangs suffered by shipwrecked sailors who for days have had to live on a very small supply of water, or to remain without water at all, you will be

able to form some idea of the great need we have of a constant water-supply. Miners who have been entombed in mines, from the fall of some portion of the roof, have been rescued alive after many days because they had a supply of water in the mine. Failing this supply, they would of course have died in a short time. It has sometimes been supposed that water could be taken in by the skin. Shipwrecked sailors are accustomed to soothe the pangs of thirst by dipping their clothes in the sea and wrapping them round their bodies. This plan, however, does not ease their thirst by the skin absorbing water, but because it prevents the skin giving off much water by its sweat-glands, and thus limits the output of water from the body itself.

The water we drink comes to us from various sources. In some towns the life-giving liquid is brought long distances from lakes. Manchester, Liverpool, Birmingham, and Glasgow are towns which derive their supply from great lakes, either natural or artificial. Sometimes rivers supply towns with water, and we have seen how important it is that a river should not receive any waste matter or sewage from houses, otherwise the people who drink its waters will be liable to suffer from disease.

In country districts water is often obtained from wells or springs. So long as such water is pure there is no objection to its use; but the danger in the case of water taken from springs, rivers, and wells is that it is very liable to receive impurities from the surrounding earth, or, in the case of rivers, from sewage matters passing into it. If the water is taken from wells, we should be very careful to see that nothing passes into it from the earth or soil around. A very excellent rule to follow where we think the water we drink is not pure is always to boil it. It should be boiled and then allowed to cool. By boiling the water, we destroy any germs of disease it may contain. Sometimes people use 'filters' to remove from the water any injurious substances; but many of the filters in common use are not to be depended on, because they cannot keep back from the water the germs and other things that are capable of causing illness.

It may be said that we get all our water-supply from the 'rain.' The sun evaporates water from the earth to form clouds. When the clouds break, rain descends, so that we have a kind of circulation in this way from the earth to the clouds, and from the clouds back to the earth. Probably rain-water is the purest of all water, except that which is produced by distilling. It is true the rain may

carry down with it in its passage through the air certain dirt particles, and even if the rain-water is pure, its taste is not very pleasant. This is because it is not aerated—that is to say, it has not had a certain quantity of air mixed with it.

The rain which falls and passes into the ground forms springs; these springs give rise to brooks, and from the joining of brooks we get rivers. In its passage through the earth, water comes in contact with rocks of various kinds, and absorbs from them certain of the minerals of which they are composed. Hence we find in ordinary waters a certain quantity of dissolved minerals, the chief mineral thus found being 'lime.' Others contain iron, magnesia, arsenic, and other things which they have gathered from the rocks, and many such waters are extremely useful to mankind in the cure of disease, forming what we call 'medicinal springs.' Sometimes water issues from the ground in a heated state, because it has come from some part of the crust of the earth where the temperature is high. We know that the inside of the earth is in a heated state, and therefore it is not surprising to find that in certain places, like Bath in England, the water should issue in the form of hot springs.

The kind of water we use is distinguished by

the absence or presence of dissolved minerals. Rain-water we call 'soft' water, because it contains no minerals at all. 'Hard' waters, on the other hand, are those which contain minerals, and the more mineral matter, especially lime, that water contains, the harder it is said to be. Water of this description costs more money for soap than soft water, because, according to its degree of hardness, it is more or less difficult to form a lather with soap.

It may be said that all the best drinking waters are of the hard description. Very soft water is more apt to be impure than hard water, and it does not contain sufficient lime as food for the bones of growing children. Where the drinking water is very soft, it is a good thing to give children a little lime-water to drink, to prevent their bones being soft, and their legs becoming bent. On the other hand, drinking water must not be too hard, but should contain a moderate amount of limy matter. If the lime in water exists in the form of chalk, which is also called carbonate of lime, we can soften the water by boiling it; but if the lime exists in another form, called sulphate of lime, boiling will have little or no effect in lessening the hardness.

If you live in a hard-water district, you will

know that the inside of kettles and boilers becomes coated with a crust of lime, so that the heat of the fire is largely wasted, because it cannot penetrate this limy crust, and so raise the temperature of the water quickly. Such kettles and boilers have, therefore, frequently to be cleaned in order to render them efficient for their work.

Very hard water is not good for our health, because, as doctors tell us, it produces derangements and ailments of the stomach and other organs. There is a very curious disease, known as 'goitre' abroad, and in Britain as 'Derbyshire Neck.' This shows itself by a swelling of a certain gland situated in the front of the throat, and sometimes this swelling is of a very large size. It is found in people who have been drinking water of a very hard quality, although it seems to be produced by other causes as well.

Water has a great deal to do with the health of everybody. We have seen that germs of diseases are apt to escape into it, and those who drink such water are liable to be infected and to suffer from the diseases in question. Some of these diseases must be well known to you by name. Cholera is one of them, and typhoid fever, or enteric fever, as it is also called, is another. Diphtheria may also be named as a third disease which we can

get from drinking water into which its germs have been allowed to pass. These facts teach us the great importance of boiling water before we drink it, if we think that it is not of a thoroughly pure character. Sometimes large numbers of people have been made ill with typhoid fever through drinking water which has been made impure by sewage, and more than one British town has suffered severely from an epidemic of typhoid fever produced in such a way.

The water in cities is brought to our houses in pipes, and whenever we desire a supply we have only to turn a tap and receive the amount we require. We need plenty of water in our houses, because we require it not merely for drinking and cooking purposes, but also for baths, for the cleaning of the house, and for the flushing of the drains. A full and free supply of water is one of the things which may be said to keep us healthy, because it enables us to remove waste matters and dirt freely and readily, not merely from our persons, but also from our homes.

Sometimes it happens that where water is scarce it may be turned off for a certain time each day. Whether this be the case or not, in many of our houses we find 'cisterns,' which are usually boxes lined with lead, and in which a store of water can be kept. The cistern is

placed at the top of the house. Water runs into it, and when the cistern is full, more water is stopped from entering by a particular arrangement acting on the tap at the end of the pipe admitting the water. If more water should come into the cistern than it can hold, it runs away through a waste-pipe, which sometimes goes down into a drain, and thus prevents the overflowing of the cistern water into the house. But it is not right that this waste-pipe should pass into a drain at all, because sewage gases may come up the waste-pipe and thus render the water impure. The waste-pipe should always be carried outside the house, so as to discharge in the open air. In this way, if we see water running through the waste-pipe, we know the cistern is overflowing.

Remember that if you have a cistern in your house it should be cleaned regularly. Even water which is usually quite pure will now and then bring mud with it, and this mud settles down in the bottom of the cistern. If it is disturbed in any way it will render the water dirty, and, what is more to the point, may cause illness in those who drink the water. A great deal of disease is caused by drinking water coming from dirty cisterns. The cistern should also be well covered over, so as to prevent dust and dirt getting into it. In some cases drowned rats and mice have

been found in uncovered cisterns, and it is not a pleasant thing to think of people drinking water in which the dead bodies of these animals have remained; besides, in such cases the water becomes unfit to drink, and will cause illness of various kinds.

CHAPTER III.

DIRT AND ITS DANGERS.

We have seen that 'dirt,' in the shape of ordinary dust in our rooms and houses, or in the shape of waste matters not carried away from our dwellings, constitutes a source of ill-health, and lays us open to the attack of disease. But under the head of 'dirt' we have also to think of certain things which are much more dangerous in respect of their power to afflict us with illness. Think of what was said regarding the floating matter of the air. You will remember that part of the floating dust of the air consists of very minute living things to which we give the names of microbes or germs. We must now learn something regarding these germs, and of the part they play in making us ill.

The 'germ' of anything means that it is the first beginning out of which there is

developed the perfect thing. If we talk about the 'germ' of a bird or a plant, we mean the egg of the one and the seed of the other, out of which its body is developed. All germs are therefore living things, and we must keep this fact clearly in our minds in order that we may perfectly understand what germs are capable of doing to us. The word 'germ' is applied to the living specks in the air because of their low and simple nature. Most of them represent the lowest forms of plant-life, being much simpler in their structure and nature than plants such as the mould which we saw to grow on cheese, jam, and other objects. The word 'microbe,' which is also used to indicate the germs we are dealing with, comes from two Greek words, one of which means 'very small' and the other 'life.' This word bears in its meaning a reference to the extremely small size of the particles we are considering.

Do not let us make the mistake of thinking that all germs are capable of producing disease. Many of them, indeed, are not merely of a harmless nature, but may be of use to us. Many germs may be looked upon as Nature's scavengers. They settle down upon dead matter everywhere, and break it up into simpler and less offensive substances. For example, the sewage of many towns and cities, as we

have already seen, is run into large tanks, and in these the germs from the air, falling into the sewage, split up its solid parts into harmless substances, leaving the watery part of the sewage perfectly pure. This is an illustration of germs being of use to man. Unfortunately, however, there are many germs of which we cannot speak in such a favourable way.

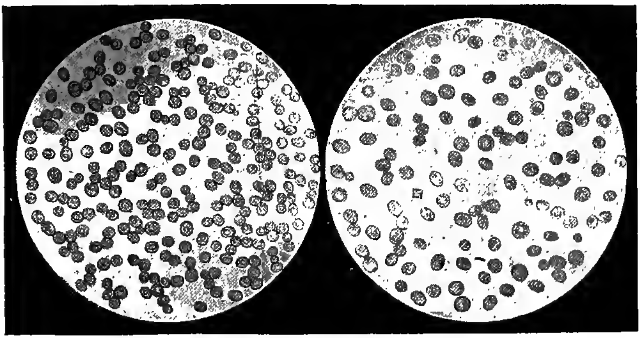
All germs being very minute living things, we require the highest powers of our best microscopes to see them; and besides, we require to stain the germs by various fluids in order that we may see them clearly. Many of these germs are not longer than one five-thousandth or one six-thousandth part of an inch. Some are even smaller. When we are measuring anything in fractions of an inch, it is well that we should know what we are describing. If we say that a germ is the one five-thousandth part of an inch long, we mean that it would take five thousand such germs placed in a line, one after the other, to make up the length of an inch. Suppose an inch divided into five thousand parts, then such a germ would equal in length one of these parts. We get in this way some notion of the extreme minuteness of these living things, which, despite their small size, are capable of causing very serious results to ourselves in the way of disease.

We have already seen that from the mould germs or spores which float about in the air we get the full-grown moulds developing themselves on cheese and other articles of food. In the same way, apples plucked from the tree, and kept in a room in which a very considerable amount of dust is present, will tend to become bad, or, as we say, 'rotten.' The germs in the air which cause the apple to decay are of a different kind from those which, when they settle on cheese, produce the coating of mould. Each kind of germ has its own part to play in the great scheme of Nature. Some produce diseases, and each germ of this kind gives rise to its own kind of illness, and to no other. Just as one kind or species of animal or plant differs from another, so the kinds of germs differ in the kind of life they represent, and in the effects they produce either upon dead substances or upon our bodies.

In order the better to understand something about the work of these germs, we may consider the history of 'yeast.' Yeast is a substance used by the baker and by the brewer. If we place yeast under a microscope, we see that it consists of large numbers of little round objects or 'cells;' these we term yeast plants. Each cell, of course, is a little living plant, and it has its own work to do in the world.

If we sow a pinch of yeast in water, nothing

will happen, the water not being a soil in which yeast can grow. But if, on the other hand, we sow our yeast plants in a fluid or substance containing sugar, such a fluid is highly suitable for their growth. We find in a little time that the sugary fluid becomes somewhat agitated, and that bubbles of gas rise to its surface. When this action, which is called 'fermentation,' is over,



Yeast Plants (greatly magnified).

we find the sugary fluid to have changed its nature in a very remarkable manner. The gas bubbles given off from the fermented sugar consist of the same gas that we give off from our lungs in the process of breathing—namely, carbonic acid gas. Left behind is a fluid known as 'alcohol.' What we mean, then, by fermentation is that work or action of yeast which splits anything containing sugar into carbonic

acid gas, which passes off into the atmosphere, and alcohol, which remains behind.

When the baker uses yeast, he wants to obtain the carbonic acid gas which raises his dough, and makes his bread light. When the brewer uses yeast, he has no use for the gas, but he requires the alcohol, which is to form part of his beer. If we examine yeast when fermentation has ceased, we find that its plants have grown in enormous numbers, and it is their growth and multiplication which has produced the action of fermentation. We now understand what is meant by the expression in the Bible about the little leaven leavening the whole lump. A few of these plants are sown in the sugary solution, and at the end of their work the few have multiplied themselves into many thousands.

Now, what is true of the yeast plant and fermentation is also true of the germs which produce disease in our bodies. If we swallow or breathe in the germs, say, of a fever, we may not receive into our bodies a large number of them, but when they have settled down in our frames they begin to grow like the yeast plants and to multiply exceedingly, and the result is that we are stricken down with disease. It is here as if the little leaven of disease leavened very quickly the whole lump of the body. Fevers and many other

diseases are the result of the growth in our bodies of the germs to which they owe their origin.

It is curious to note that each disease which is caused by germs imitates very closely the life of an animal or plant. The animal is born, it grows, it comes to its full growth; then it declines, becomes old, and finally dies. In the same way a fever begins, as we have seen, in a small way when the germs are received or sown in our bodies. As the germs multiply, the fever becomes severe, then it comes to a head, and finally dies away, and if the patient's strength holds out, he then gets well. Life is just as clearly represented in the case of a fever as it is in our own bodies, and in the stages that these bodies of ours pass through as we advance from infancy to old age.

Each germ, being a living thing, requires its own kind of soil and suitable surroundings in which to flourish. The germ of a fever called typhus fever, for example, lives in the foul air of overcrowded rooms. More especially if the people in the rooms are poor, ill-nourished, and of dirty habits, there is every likelihood of typhus fever breaking out. You may have read in your school-books of the labours of John Howard to reform jails, and to change them from their former wretched and dirty state into the clean and healthy places which they are to-day. In

these old days, large numbers of persons died from a trouble called jail-fever. This fever was typhus fever, and it broke out in jails because they were overcrowded, ill-ventilated, and dirty. We never hear of jail-fever to-day, because the modern jail is a clean and well-ventilated place. The germ of typhoid fever lives and breeds amongst sewage matter, and when sewage is allowed to escape into drinking water we can understand how the fever is conveyed to us. Each germ, therefore, is like a seed wanting its own kind of soil; and in not growing unless it gets that soil, it resembles very closely a living plant.

The next point which we have to notice is that each kind of germ gives rise to other germs like itself, and to no other kind. If we sow peas, we expect to find peas growing up from the seeds; and so it is with the germs of disease. The germs of measles produce measles, of cholera, cholera, and so on.

When germs pass from the bodies of people who are suffering from a fever, they escape into the air around them. This is the case with many infectious diseases, such as measles, scarlet fever, and smallpox. Germs may pass into water, and through water into milk. The germs of diphtheria, typhoid fever, and cholera are mostly conveyed to us through water which has thus been polluted. Scarlet fever may also

come to us through milk which has been infected. If on a dairy-farm some person is ill with scarlet fever, the germs are very apt to pass from this person's body, and thus to infect the milk. All those who drink such milk run a very serious risk of catching the disease.

Other germs can only affect us when our bodies are actually inoculated with them through a cut or wound. Thus, if we are wounded, and are not careful to keep the wound very clean, certain germs may pass into the wound and cause blood-poisoning. You have no doubt heard of a very serious trouble called 'lockjaw.' It is so named because the muscles of the jaws and the general muscles of the body are thrown into spasms. Lockjaw is caused by a germ which is found in the earth around us. It cannot do us any harm so long as there is no break in our skin, but if the lockjaw germs get into our bodies through some wound, or even through a scratch in the skin, they are then placed in a position in which they can produce all their serious effects.

We may well ask ourselves now if there are any means we can employ to avoid being attacked by this great army of germs which seems everywhere to surround us. One thing we can all do—namely, try to keep ourselves in good health by breathing fresh air, taking sufficient outdoor exercise, and carefully attend-

ing to our personal cleanliness. A person in perfect health is much more likely to repel the attacks of disease-germs than one whose bodily condition is not so good, for even if the germs do fall upon him, they will probably be destroyed in the body before doing any harm.

But we must also remember that every germ must have come from a case of the disease it represents. No germ can come into existence of itself. It is a living thing, and, like every other living thing, must have had a parent to produce it, that parent being the germ which existed before it. We see, first, that no fever can be produced unless we are infected with its germs; and second, that its germs can only have come from a previous case of the fever. Now, what can we do to prevent this spreading of germs, and to keep them from being conveyed from those who are sick to those who are well? The answer is that we should take great and instant care of the first cases of illness. If we could at once separate those who are taken ill from those who are well, and prevent any germs from escaping from the bodies of the sick persons, we should not have so many cases of fever spread abroad.

Whenever illness appears it is of great importance that the sick person should not

be allowed to mix with other people. If his illness is of an infectious kind, he should be at once separated from all other persons. This is what doctors and others are trying to teach people. When scarlet fever or measles breaks out in schools, we all know that sometimes large numbers of the children are attacked, and have to be nursed for weeks. The beginnings of such illnesses very often come from one child who has suffered from the fever and who returns to the school before he is quite well. He gives off from his skin or from his breath the germs of the fever, and other children sitting beside him, or playing with him, receive the germs and are infected.

It is a great thing to be able to prevent disease, and I have tried to show you in this way how we might escape much illness if people were only careful to see that a person who has suffered from a fever is not allowed to mix with other people until he is quite well. We know that the air contains numbers of the germs of diseases. They can only get into the air through the carelessness of people who have cases of illness in their houses, and it is therefore very important that we should all be taught that so long as we keep cases of fever by themselves, we are able to prevent the spreading of such troubles.

The list of ailments which are caused by germs is a very long one. We have seen that such diseases as cholera, typhoid fever, typhus fever, smallpox, scarlet fever, and measles are germ-produced diseases. To these we can add whooping-cough, mumps, influenza, diphtheria, chicken-pox, and several others. Consumption, which you all know is a very serious trouble, causing wasting of the body, also comes from the attack of a particular germ. This disease teaches us how much we can do to prevent illness. The germs of consumption are coughed up from the lungs of consumptive people in millions every day. When the coughed-up matter dries, the germs also dry and pass into the air to form part of the air-dust. They are also found in the dust which sticks to the walls and roofs of rooms in which consumptive people have lived. If we breathe these germs into our lungs when we are in good health, it is not likely that we shall be affected by consumption, because the healthy lungs destroy the germs. Like seeds falling on barren ground, they do not find a soil in the healthy lung in which to grow. But if we are in ill-health and our lungs are weak, and we breathe in the germs of consumption, then it is very likely that the disease will be set up in our bodies.

In order to prevent consumption, we see

that it is necessary that all the matter that is coughed up from the lungs of people who are suffering from the disease should be instantly destroyed. If this were always done, we should find cases of consumption to be very few indeed. We are all liable to suffer from these consumption germs being scattered abroad in the way I have described, and so attempts are made to stop the disease by putting up notices warning people of the danger of spitting in the streets and other public places.

In addition to disinfecting—that is, killing—the germs coughed up from a consumptive person's lungs, we ought to pay special attention to the regular cleaning of the room in which he lives. Many cases of consumption are set up in people through their going to live in rooms or houses in which consumptive people have dwelt. These rooms and houses have not been disinfected and purified, and the germs are thus left in them.

In order to kill the germs of disease, we have to employ certain substances called *disinfectants.* Substances of which no doubt you have heard, such as carbolic acid and the like, have the power of killing germs, and when we mix these substances with water, we can steep infected clothes in the solution we make. We can also apply such sub-

stances to the matter coughed up from consumptive lungs, and to any other matters from infected bodies which contain the germs of disease. For all ordinary purposes a tablespoonful of carbolic acid added to forty or fifty times as much water forms a very good mixture for the destruction of disease-germs.

In the case of poor people who are affected with fever, and also in the case of persons who are better off in the world, it is well that they should be at once taken to a fever hospital. We can all see that it is very difficult indeed, where one person in a family has fever, to keep the other persons from taking it. A great deal of pain and misery will probably be saved, and much risk will be avoided, if, when any person is seized with fever, he is at once taken to a fever hospital. There he will be well attended to and nursed, and care will be taken that no germs pass from his body to the air or to water to infect people who are healthy. In most towns, and also in other places, fever hospitals are now built, and they are very useful in preventing infectious diseases from spreading.

If we now sum up all we have learned in this lesson on dirt and disease, we see, first, that the dust of the air contains a certain number of germs capable of producing disease when they gain admittance to our

bodies. Second, we see that each germ is a living thing, and that when it multiplies it produces germs like itself. Third, we are taught that every case of fever or other disease caused by germs can only arise when the germs of that disease, coming from a previous case, have been received into the body. Fourth, we learn that by taking care of the first cases of a fever, and separating them from all contact with people who are well, we can prevent the spread of fevers, and keep one case from multiplying itself into many. Fifth, we see the great good of destroying disease-germs wherever we meet with them, and this is done by the use of substances we call disinfectants; or it may be effected by the use of steam. By means of a special machine, clothes and bedding which have been infected can be steamed so as to kill all the germs they contain, and thus rendered safe for use again.

CHAPTER IV.

MORE ABOUT AIR AND VENTILATION.

WE must now return to the house, and learn something more about air in relation to health. Keeping in mind all that was said in our first lesson regarding air as necessary

for life, we must now look at air as it is affected by ourselves. We must also get some notion of the manner in which, in the case of our houses, we can get a supply of fresh air, and get rid of the impure air which we have seen to be a source of illness and disease.

You have probably been taught that what we call the 'atmosphere' is a great shell of air surrounding the earth. How thick this air-shell is we do not know, but we do know that it thins off as it leaves the earth, until at last it may be regarded as disappearing into a lighter substance which seems to fill all space, and which is called the ether. Air is thus a kind of personal belonging of the earth on which we live. Astronomers tell us that the moon has no atmosphere, and also that it is destitute of water. If water and air are absent from any planet, no life can exist thereon; therefore the moon can have no life upon it.

You were told in a previous lesson that if we are deprived of air for even a few minutes we die. In so far as solid food and water are concerned, we can still live even if deprived of these for a certain number of days. If we seek to know the amount of fresh air which a man requires every hour, we may put this amount down at about 3000 cubic feet. This seems a very large amount of air

indeed, but we must not forget that a person spoils more air than he breathes. Hence, when we require a supply of pure air, we must get rid of a very large amount which has been rendered bad through our breathing.

Let us now see of what the air consists. It is a mixture of two gases called oxygen and nitrogen. When I say a 'mixture,' I mean that the particles of these two gases are merely in contact with one another, but are not chemically united in the way in which the particles of oxygen and hydrogen gas are united to form water. Water is a chemical compound, and to separate the two gases of which it consists we require to perform a chemical experiment. The two gases in the air are not so united together, but are merely mixed.

If we analysed 100 parts of air we should find, roughly speaking, about 23 parts of oxygen gas and 77 of nitrogen. We might think that if oxygen is the gas which animals and plants require, there would appear to be very little of it in the atmosphere as compared with the nitrogen gas, but the proportion is quite sufficient for our use. Nitrogen is what we call an inert gas. It merely serves to dilute—that is, to mix with and weaken—the oxygen, and has no effect whatever upon our bodies. We could not breathe pure oxygen. That would cause our bodies to burn away at

too great a rate. Pure oxygen is only used for breathing by persons who are very ill, and who have a difficulty, as in inflammation of the lungs, in getting into their blood the necessary amount of this gas.

In addition to these two gases, which really constitute 'air,' we find that the atmosphere everywhere contains small quantities of other things. Thus, in ordinary pure air we find a certain amount of carbonic acid gas. This should not amount to more than 4 or 5 parts in 10,000 parts of air. In impure air the quantity of carbonic acid gas is very much increased, and, as we have seen in a previous lesson, it is the presence of this carbonic acid gas, breathed out from our lungs, which is one of the most common causes of the impurity of the air, and necessarily also of disease.

There is always a certain quantity of water, in the shape of vapour, suspended in the air. The quantity of water carried by the atmosphere depends on the degree of heat of the air. If the temperature is very high, more water can be carried off from the earth. At the same time, the air may not in such a case appear to be loaded with moisture. We may consider that the amount of water in the air amounts to from 1 to 1½ per cent. of its bulk.

Another thing that we meet with in the air

is ammonia, which in pure air should be present only in the merest traces. If we find it in greater quantity we know that the atmosphere is of an impure character.

Another element of air is 'ozone.' Ozone is found only in the purest of air. It really represents oxygen gas in a very active form. It is produced in the atmosphere during thunderstorms by the action of the electricity upon the air, and it is also formed during the fall of snow. This element is specially found in the air of mountains and in that of the sea, and we are told that to the presence of ozone the air in these localities owes a great deal of its healthful nature. We do not find ozone in the air of towns or in the air of our houses. If it is blown across a town, it speedily disappears when it comes in contact with the impurities of the air.

In addition to these substances in the air, we must not forget the dust, of which mention has been made in a previous lesson. This floating dust, of course, forms no part of the air itself, and in pure air such dust is not found.

Let us now see the differences between the air before it has been breathed, and after it is given off from our lungs. In the first place, the air which is breathed in is, of course, of

the temperature of the atmosphere around us. If the temperature of a dwelling-room, say, is 55 or 60 degrees as indicated by a thermometer, the air we take into our lungs will have the same degree of heat. On the other hand, the air which we breathe out is of the temperature of the blood—namely, about 98·4 degrees, this being the natural blood-heat. We must remember in this connection that the air we take into the lungs is there brought in contact with the blood, and is raised by it to its own temperature.

In the second place, the air which we breathe in contains the amount of oxygen already mentioned as proper to the atmosphere; together with a little carbonic acid gas. That which we breathe out has had its oxygen lessened, because so much of it has passed into the blood; while the carbonic acid gas is much increased in the air we give out, because it is waste matter which has come from the blood.

In the third place, whatever the amount of water the air contains before it is breathed in, it is loaded with water when it comes from our lungs. As a proof of this, you have only to remember what happens in a close room, especially on a cold night, or in a crowded railway carriage, the windows of which are closed. The windows at first

become dim, and then later on we find moisture condensing on the cold glass, and streams of water trickling down the inside of the panes. This teaches us that in addition to containing a large amount of watery vapour, the air coming forth from our lungs is also heated.

The air which is breathed out contains a certain amount of ammonia, and we can also detect in it a little of what is called 'organic matter.' This matter consists of the worn-out cells and particles derived from our bodies. It is the cause of the close, stuffy smell of ill-ventilated rooms, and we know this 'organic matter' to be the special substance in the air in which the germs of typhus fever breed and grow.

Remember when we talk of breathing, and when we say that the blood is purified by the lungs, that this duty is not the only one performed by them. It is quite true that we breathe out waste matters from our lungs, such matters being also given off from the skin and kidneys. But in breathing we also perform a second duty. We not merely give off waste, but we also take oxygen into our blood. Now, oxygen gas is a very important, nay, an essential, part of our food-supply. We may say that if oxygen is not put into the blood, all our other foods will be of no

service in nourishing our bodies. Suppose we have a fire laid in a grate. We know that before the fire can be made use of we have to put a light to it, in order to cause the sticks and coal to burn. Suppose now that our ordinary foods are represented by the coal and sticks in the grate, then the oxygen we breathe into our lungs would represent the light, without which the fire could not be made to serve its purpose. We must always bear in mind, therefore, that in addition to water and solid foods our diet includes oxygen gas, which in one sense is the most important food of all.

It may prove useful to us to know of some simple test whereby we may be able to tell whether the air in a room is pure or not. Suppose we get from a druggist a small bottle of lime-water. The lime is dissolved in the water, and the water itself is perfectly clear. If now I blow through a tube into the lime-water, and continue to blow for some time, I see the lime-water become first of a cloudy and then of a milky tint. Last of all, I should find a white powder to settle in the bottom of the bottle, this white powder being chalk. The chemical name of chalk is carbonate of lime, and I have made the chalk by adding carbonic acid gas from my lungs to the lime in the water. In other words,

I have made a chemical compound by bringing together the substances of which it is composed—lime and carbonic acid gas.

This little experiment has been applied to enable us to test the air in a room. Of course, the air of the room must not be disturbed, and the doors and windows must be kept shut, while it is also advisable that the damper of the grate be put down to prevent the escape of air by the chimney. These precautions having been taken, we provide ourselves with a bottle of clear lime-water, and a wide-mouthed stoppered bottle which holds $10\frac{1}{2}$ ounces. We stuff a handkerchief into this bottle, so as to fill it as completely as possible, before we enter the room. On entering the room and closing the door quickly, the handkerchief is rapidly drawn out so as to take out the air which was in the bottle and allow the air of the room to enter it. Into the bottle, which is now full of the air of the room, we place half an ounce of clear lime-water. The stopper is put in and the bottle shaken. If the lime-water remains clear, then the air may be regarded as pure. If the air is impure, the lime-water will become more or less milky, according to the amount of carbonic acid gas which is present in it; and we may take the quantity of carbonic acid gas, shown us by the milkiness of the water, to tell us the

amount of other impurities which are likely to be in the air.

Seeing that it is necessary for our health that we should receive a supply of pure air, and that we should get rid of impure air, we must now try to understand what we can do to secure this end. The chief things which we have to fight against and to get rid of are the carbonic acid gas and the organic matter which represents the worn-out particles of our frames; in place of these we need a supply of life-giving oxygen.

Very many people do not appreciate the need for fresh air, and as a consequence are content to live in overheated and stuffy rooms, the atmosphere of which is very injurious to their health. If we come directly out of the fresh air into an overheated room, we feel the atmosphere close and stuffy; but we cannot remain long in such a room without noticing that in a short time the stuffy sensation disappears. We get accustomed to bad air; and it is just this power of accommodating ourselves to what is bad for us that makes many people neglect to obtain a supply of fresh air. We become 'tolerant' of bad air, as we become accustomed to a good many other things that are injurious, but none the less surely is our health injured because of this fact.

A famous scientific man, Claude Bernard,

once put a sparrow under a glass jar. The air contained in the jar was sufficient to maintain the life of the sparrow for three hours. At the end of the second hour, when the sparrow had yet another hour to live, a second and fresh sparrow was placed under the jar. This second sparrow at once tumbled over and died, because it breathed the air which had been rendered impure by sparrow number one, although it would have served to keep the first sparrow alive for another hour. The reason was that the first sparrow had become accustomed to and 'tolerant' of the bad air under the jar, whereas the second sparrow, like a person entering a stuffy room, experienced in an extreme degree the effects of passing from a pure into a foul atmosphere.

When we get rid of foul air for fresh, we are said to 'ventilate' our houses. It is a far more difficult thing than many people think to get a full supply of fresh air. I have said that a human being spoils much more air than he breathes, because he is sending forth into the atmosphere the waste matters of his body coming from his lungs. We have seen that a man needs 3000 cubic feet every hour he lives. He does not pass this amount of air through his lungs, but he spoils sufficient air to cause him to require the amount stated if the air in which he lives is to be kept pure.

Let us suppose a man placed in a box 10 feet long, 10 feet broad, and 10 feet high. Here he would be living in 1000 cubic feet of space. In order to keep the air of the box pure, we should have to change it three times every hour. Say at one o'clock he starts with 1000 cubic feet of pure air in his box, at twenty minutes past one we should require to sweep out the air in the box, and give him a second 1000 cubic feet, whilst at twenty minutes to two o'clock we should then supply him with a like quantity, and again at two o'clock. It is, however, impossible in our ordinary life to do such a thing, and when we say that a man requires 3000 cubic feet of air every hour, we really mean that that amount of fresh air should be gradually supplied to him during the hour. The foul air must, of course, be as regularly got rid of.

The difficulty of ventilation lies in getting the amount of fresh air that we need without draught. We could easily ventilate any room and sweep out the foul air by opening the doors and windows widely; but in cold weather this plan would have the effect of giving us colds and serious lung troubles. Hence people have endeavoured to devise ways and means of allowing the fresh air to enter rooms gradually, and as gradually getting rid of the foul air.

Movements of the outside air are called winds, and we all know that wind is the result of differences of temperature in the atmosphere. When the air over a certain spot is heated, it expands, and becomes lighter. It must, therefore, rise, whereupon cold air from surrounding districts rushes in to take its place, thus producing a wind.

The air of a room is warmer than that outside, because of the heat produced by fires, by lights, and even by our own bodies. The hot air inside the house draws in cold air from the outside, as it were. The warmer and lighter air passes up towards the ceiling of the room or goes up the chimney, and the colder air comes in beneath the doors, through the keyholes, by the chinks of the windows, and in some cases even through the walls of the rooms themselves.

In considering the amount of air needed, we have to think not only of the human beings in a room, but also of the lights that are burning in it. We know that a common gas-burner will produce in an hour a very large amount of carbonic acid gas; so that instead of merely reckoning that each person in a room requires 3000 cubic feet of air per hour for himself, we must add largely to this quantity where lights are used, if we are to preserve the air in a pure state. The ad-

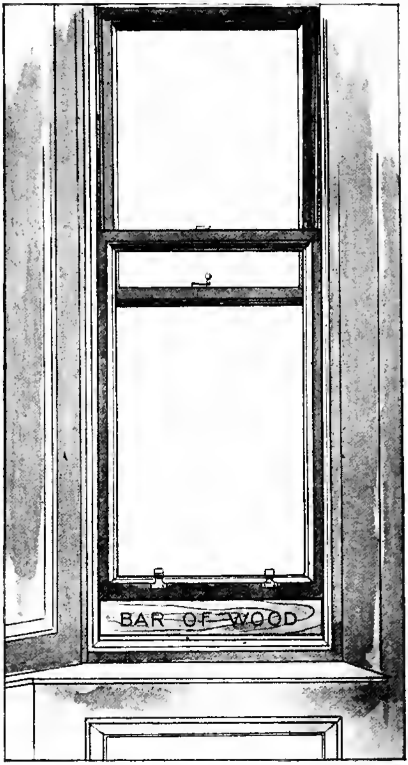
vantage of having electric lights in a house is, that whilst they give off a certain amount of heat, they do not produce the impurities of the air which are given out by naked lights, such as gas-jets, lamps, and candles.

The larger a room is, the less air impurity will be present; but as many of our rooms are very small, there is the greater need in such cases to use some system of ventilation which will give us a pure atmosphere. When we make arrangements to ventilate our houses, we should see that the air comes from a pure source. It should not be drawn from other parts of the house, or through passages in which bad air is apt to be found. It will be well, too, if we get a constant supply of fresh air, and not an irregular supply.

It is very difficult, as our houses are built, to have perfect ventilation. When we think of it, an ordinary room is like a box which we have done our best to render air-tight. If we shut the door and close the windows, we can see how our room is like a shut box. We depend upon pure chance for giving us the air which is so necessary for our life and well-being.

The window is the first and most convenient source of ventilation. We can always flush a room out by opening the window and door; but we have seen that there are many objections to this plan, on account of the cold and

draught which it causes. A very useful plan of ventilating a room is that of raising the



Ventilation between the Sashes of a Window.

bottom sash of the window on a bar of wood, leaving the top sash untouched, so that the air comes in between the sashes. If we do

this, no direct draught blows in upon us, and the air receives an upward movement, and is slightly warmed in the upper part of the room before it descends to the lower portion. Sometimes the top sash of the window may be drawn down a few inches, and zinc gauze placed across the opening. We may also fix into the window a pane of glass provided with movable ventilators, which we can shut or open as required.

The chimney of a room forms in many cases the only ventilating tube or shaft the room possesses. An open fire has this advantage at least, that a current of air is drawn up the chimney, and as a result fresh air is brought into the room. Even when the grate is empty, the chimney may act in this way; but if no fire is present, we may find a down-draught from the chimney, which also brings in air. We should take care that the damper of the grate is never closed, because in that case the ventilating power of the chimney is lost.

If fresh air is introduced into our rooms, we must also provide an outlet for the foul air. This may be accomplished by putting a valve opening into the chimney near the ceiling. Such valves allow the foul air to pass up the chimney, but they only act when the pressure of air from the room into the

chimney is greater than that from the chimney into the room. Public halls, churches, and like buildings have ventilators in the roof, opening directly into the air. Many of these are useful enough, although they do not always act as perfectly as we could wish.

In many rooms an opening is made through the outside wall at the floor level, and the air which passes in through such openings is carried into the room by tubes running up the corners of the room. These tubes, which can be closed or opened by valves placed at the top, rise to such a height that they bring in fresh air above the level of the people in the apartment. The proper course for fresh air is to pass upwards into the room, and then to descend to mingle with the air already contained in it.

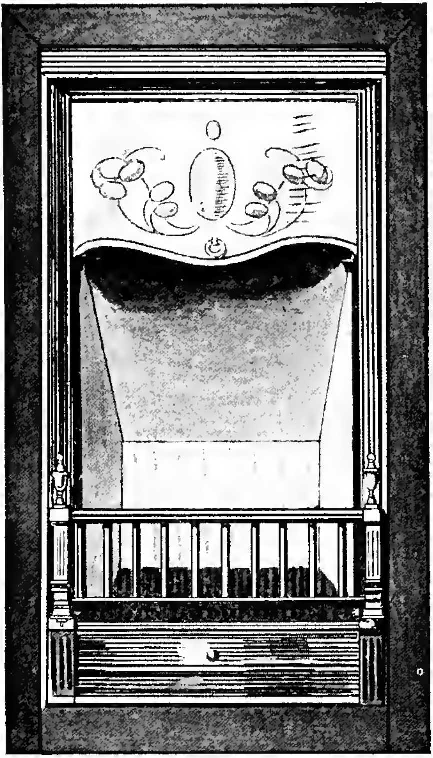
Some buildings are ventilated by means of machinery, such as ventilating fans. These are usually driven by electricity, one fan being used to bring air into a room or building, and another to take away the foul air. We should remember that in order to make air pass in and out of our houses at the rate and in the quantity we want, it is necessary to move it. Therefore some kind of machinery like fans, if we could have them in our homes, would be the best means of keeping the air moving, and of giving us a sure supply of fresh air.

The lighting and warming of a house are carried out by means familiar to us all. Every light we know, except perhaps the electric light, produces carbonic acid gas, heat, and water. These are given off to the air, so that every naked light is a source of air impurity. Candles are not much used in our houses to-day, whilst lamps have been largely replaced by gas and electric light.

Paraffin-oil is now used in most lamps. The best lamps are those which possess circular wicks, or which have two flat wicks placed parallel to each other. If lamps are used, we should be careful to see that the oil consumed in them does not possess what is called 'a low flash-point.' This means that in the event of a lamp being overturned, and the oil catching fire, it will not easily explode. On the other hand, when very cheap oils are used and an accident occurs, an explosion is much more likely to happen. We should see that all our lamps possess a broad base or stand, so that they will not be easily overturned. The oil in the lamp must not be allowed to sink too low, because the risk of an explosion is very much increased where only a small quantity of oil is left in the reservoir.

With regard to gas-lights, we find that great improvements have been made in recent years, giving us a much better light with

less consumption of gas. You may know, for example, that what we call incandescent

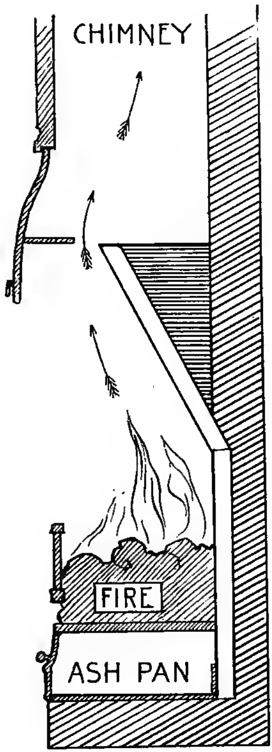


Improved Sitting-Room Grate.

gas-lights, in which a 'mantle' is used, give us a much greater amount of light, whilst the quantity of gas which is consumed is

much less than where an ordinary burner is used.

Different nations use different means for



Section of Improved Sitting-Room Grate.
(The arrows indicate the course of the smoke.)

warming their dwellings. As a rule, the air of a room should show a heat of between

50 and 60 degrees; but it is sometimes necessary in the case of illness, and for the safety of infants and very old persons, to raise the heat to 65 degrees. The common way in our own country of heating rooms is by means of the open grate. As open fireplaces are too often constructed, this is a very wasteful form of using coal, because only a small portion of the heat is thrown into the room, by far the larger part passing up the chimney. At the same time, the open grate has its advantages, because, as we have seen, it is a ventilating shaft, a current of air passing up the chimney, and therefore drawing in fresh air from the outside.

It is possible, however, to make the ordinary open grate consume its coal better, to give us more heat, and to cost us less for coal, by making a few alterations in it. If the grate be made so as to have less iron, and more brick about it, than is usually the case, the amount of heat produced will be greater. The back of the fireplace should project or lean over the fire, and the opening of the chimney must not be too wide. The bottom of the fire should also be made deeper when measured from front to back. The slits in the bottom of the grate must be narrow, and the front bars should also be narrow. There is an open space, as we know, below the

fire. This should be closed in front by an iron shield. A grate thus altered will use less coal, and give out more heat, than one of the ordinary kind.

What are known as 'well fires' are fires which burn below the level of the hearth. These, when properly attended to, give out a large amount of heat, and consume very little coal indeed, while they are very useful in aiding the ventilation.

Stoves of various kinds are also used for heating houses. Those which are of the closed or shut-in form are the most economical, and also produce the greatest amount of heat. Stoves, however, have a tendency to make the air of a room too dry, whilst very often a disagreeable smell is given off from them. Many people are accustomed to put shallow pans of water near the stove, so as to avoid too much drying of the air. Where gas-stoves are used for any purpose, we should be very careful to see that the flue opens into a chimney, so that the waste gases are safely carried away. Large buildings are often warmed by hot air, by steam, or by hot water carried in pipes. Hot water is probably the best means of heating such buildings, because it is less dangerous than steam, and not so apt to cause explosions.

CHAPTER V.

THE HOUSE AND ITS SURROUNDINGS.

Very necessary is it for our health's sake that we should live in a house that is healthy. You have been told in a previous lesson that where any form of dirt or waste matter is allowed to accumulate about a house or in its drains, disease will very likely attack the inmates. Cleanliness of the house is, therefore, just as important as cleanliness of the body. When we come to think of it, a house has many points of resemblance to the man who lives in it. Like a man, the house requires plenty of light; and like the people who live in it, it also demands plenty of air. Houses that do not have plenty of light, and those crowded together so that air does not pass through them and about them, cannot possibly be regarded as healthy dwellings. When we go to the slums of a great city and notice the absence of light and air in the dwellings of the poor, we cannot wonder that they grow up with feeble bodies, and that disease is very frequent amongst them.

It has already been shown you how over-crowding amongst human beings causes disease. We saw that typhus fever only appears where

we find people crowded together in rooms too small to contain them, and where the dwellings are dirty and the people themselves unclean and their bodies ill-nourished.

In order that our house may be healthy, we must make sure that the soil on which it is built is of a dry character. If you live in a house which is damp, you will probably suffer from rheumatism, and you will also be more liable to the attack of consumption. Two very distinguished doctors many years ago proved that the number of deaths from consumption always fell after the ground was well drained, because the houses were no longer damp. The effect of dampness in a house is to cause a low state of health, in which the germs of consumption are most likely to find a lodgment in the lungs.

We must have all round the house plenty of fresh air. In some towns we find collections of what are called 'back-to-back' houses. The back wall of one house forms also the back wall of another, and thus in both houses the windows and the door are necessarily found only at the front. From the very nature of the case, such houses cannot be so healthy as 'through' houses. Where the air is not readily changed, and where there is no free circulation of air about the house, the food, especially milk, is apt to become tainted, and danger

comes from this as well as from other sources of disease.

Equally important is the question of light. You all know that a green plant grown in a dark cellar does not develop the colour which is natural to it. Its leaves are blanched and white, and the plant grows up in a very weakly state, if it does not actually die before it attains its full growth. The human body is in the same position as the plant. If we bring up children in a place where insufficient light is provided, they do not develop the rosy colour and the healthy appearance we see in children brought up in the country. We cannot be healthy unless plenty of light is afforded us, any more than we can develop sound bodies in the absence of fresh air.

Sunshine, too, is an important factor in the production of perfect health. It is easy to prove that sunshine has a marked effect on the welfare of human beings. Certain diseases are cured by the exposure of the body to the direct rays of the sun, but more important still is the fact that sunshine actually prevents disease. Where rooms are flooded with the light of the sun, germs are killed, so that we may regard sunshine as one of our best, as it is certainly our cheapest, germ-killer or disinfectant.

If at any time we were tempted to doubt

the effect which sunshine, or even ordinary light, exerts in preventing disease, we should remember what actual experiments have shown scientific men. If we expose the germs of consumption to the action of the direct rays of the sun, these germs are killed in from four to six hours. If the germs are exposed to ordinary daylight—that is, not direct sunshine—the germs will eventually be killed, although a longer time will be occupied in the good work.

There is no doubt that sunshine acts upon disease germs of other kinds, and tends not only to stop their growth, but actually to kill them. In this sense we may very well say that the germs of disease are 'the children of the dark,' and that light is their great enemy. Further, we see that under all the circumstances of our life, light, and plenty of it, and especially sunshine, should be enjoyed as a means of preventing disease and of preserving our health.

CHAPTER VI.

THE CLEANLINESS OF OUR BODIES.

WE must now turn to the important matter of the cleanliness of our bodies. No one requires to be told that a person whose skin, hair, or clothes are allowed to remain

dirty, must be an object of offence to everybody around him. More than this, we may say that he is liable, in consequence of his dirty habits, to be attacked by certain diseases, amongst these being diseases of the skin. We have already seen that the use of soap is to remove the dirt particles which are engrained in the skin. Soap may be described as consisting of some form of fat united with something called an alkali. An 'alkali' is the opposite of an acid, such as vinegar, and we find examples of alkalies in substances such as soda and potash. Soaps used for the skin are made of a fat and soda. Those which are made of fat and potash are generally of a coarser nature, such as soft soaps, which are very effective in cleaning floors and woodwork generally.

For the perfect cleansing of the skin it is necessary that the water should be soft. We have already seen the difference between hard and soft waters. Where the water is very 'hard,' a considerable waste of soap takes place, because it is more difficult to make a lather with hard than with soft water, and we have, therefore, to use more soap with the hard water than with the soft. It has been estimated that if the water of London were a little less hard than it is, the saving in money spent on soap would

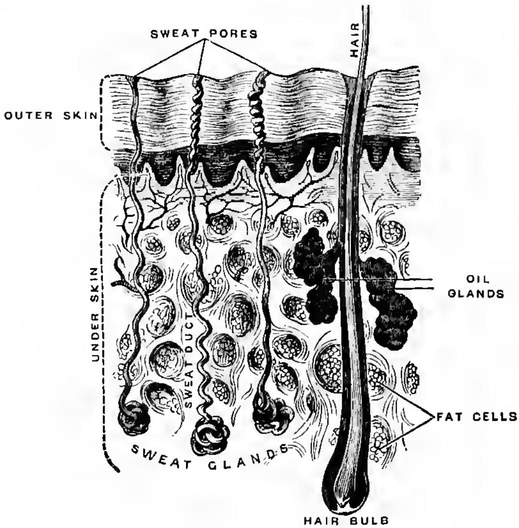
amount to many hundreds of thousands of pounds per year.

When we wish to cleanse our skins properly, we must use hot water. The hot water exercises a dissolving action on the dirt, and assists the soap in removing it. With respect to baths, the hot bath is undoubtedly that which alone can perfectly cleanse the skin. Many people take cold baths, and some are accustomed to bathe in the sea or in rivers. The difference between the cold bath and the hot bath is that the cold bath is a stimulant. It braces up the body, and gives a tone to the muscles and the nervous system; but it does not cleanse the body, and has little action in removing dirt from the skin.

Most of you know that there are other kinds of baths than the simple hot bath. Certain of these are known as Turkish baths and Russian baths. They depend for their action on heat, but the heat is supplied in the form of hot air. This causes the skin to act very thoroughly and to produce profuse sweat or perspiration, thus ridding the skin completely of any engrained dirt it may contain.

In order to understand why we should always attend to the cleanliness of the skin, let us glance for a moment at the structure or build of the skin, and also learn something

of the duties it performs. We might very well describe the skin as a kind of lung spread over the surface of the body. It consists of two parts—an upper layer, which we may call the 'outside skin,' and a lower layer, or 'under-skin.' The outside skin has



Section of the Skin.

neither nerves nor blood-vessels. You could pass a needle through it, and you would neither feel pain nor draw blood. But if the point of the needle happened to pass downwards, you would then be conscious of pain, and a spot of blood would appear. This is

because the needle has touched or wounded the second layer of the skin. This 'under-skin' is very sensitive. In it we find the ends of the nerves by which we exercise the sense of feeling or touch. When we touch any object, we are really feeling it with the nerves of the under-skin through the upper or outer skin. If you happen to knock off a little portion of the upper skin from the end of your finger, and bring the injured part in contact with any object, you will certainly feel more acutely, but the feeling will be one accompanied by pain.

The skin has as its covering the things we call 'hairs.' On man's body the hair is very slightly developed, save on the head. In the case of the lower animals, we see this hair forming a very complete covering to the body, protecting it against the effects of cold.

The skin has embedded in it certain little organs, which under the microscope appear to our eyes like coiled-up tubes. These are called sweat-glands, because into them there pass from the blood certain waste matters we call sweat or perspiration. The end of each coiled-up sweat-gland passes right up to the top of the skin in the form of a tube, and this tube opens on the surface in a little aperture called a pore. The pores of the skin therefore represent the mouths of the

sweat-glands, and it is from these little mouths that the perspiration is discharged on to the surface.

Bearing in mind the fact that one of the functions of the lungs is to get rid of waste matters, we can readily understand why the skin might be called a lung spread over the surface of the body, for it performs in part the same duty as the lungs. The perspiration which it gives off consists largely of water, with some minerals contained in it. Common salt is one of the chief of these minerals. Heat is also given off from the skin. The perspiration usually disappears by evaporation, without our noticing it; but if we have been taking a good deal of violent exercise the sweat does not disappear so quickly, and we are able then distinctly to feel the skin very damp and moist, and even to see drops of perspiration showing themselves on the brow and on other parts. We must, however, remember that the skin is always acting. It is a mistake to think that we perspire only when we have been running or taking exercise, for the truth is we are always perspiring, always getting rid of waste, and all that the exercise does is to increase the amount of perspiration which is given off by the sweat-glands. The healthy skin is really a moist skin; indeed, a perfectly dry skin is a sign of

ill-health, and is a well-marked symptom in cases of fever.

That the skin should be kept clean, therefore, goes without saying, because if perspiration is always being given off from the sweat-glands, there must always be a certain amount of waste matter to be removed by washing.

But there is another reason why the care of the skin is a most important duty. The upper skin is composed of untold thousands of very minute bodies called 'cells,' which require a powerful microscope to see them. They lie in layers in the outer skin, those of the lower layers being somewhat thicker than those on the top. Indeed, those at the top are mere dry scales, and are given off from the skin every day of our lives in large quantities. They pass away into the air as invisible dust. In order that the outer skin may be renewed and may retain its thickness, we find that new cells are always being produced below, and these in their turn become dry scales when they arrive at the surface.

Now, if there is taking place in our skin this perpetual giving off of the old cells, and as constant a growth of new ones, we see that in addition to the removal of the dirt which the skin has received from the outside, we have also to think of the getting rid of the old cells of the skin themselves.

Many of these cells are worn off the skin by the friction of our underclothing. This fact teaches us that it is necessary for health and cleanliness that our underclothing should be frequently changed and washed, for it becomes loaded with old skin particles, which give to garments that have been worn too long a most disagreeable smell. We know that many of the lower animals moult, or change their skin covering, once a year; and we might say of human beings, considering that the upper skin cells are being perpetually given off, that they are always moulting.

Having regard to the fact that the skin is an organ which, as part of its duty, gets rid of so much bodily waste, we see that any serious interference with its work may result in grave illness or in death itself. Suffocation can be easily caused by interfering with breathing, as in the case where a person, instead of taking into his lungs pure air, breathes carbonic acid gas. It would, of course, be also possible to suffocate a person by forcibly closing his mouth and his nostrils, so that no air at all could gain admittance to his lungs.

We could also produce a similar result by closing the pores of the skin, which are always giving off waste matter. The real cause of death when a person is suffocated is

that waste matters, which should be got rid of, are kept within the blood, and thus cause death by a species of poisoning. When the chicken is being developed inside the egg, it breathes at a certain stage of its existence, and we can easily kill it by varnishing the egg-shell, thus preventing the air passing through the pores of the shell to the young bird within.

In some animals, the skin plays an even greater share in getting rid of bodily waste than in ourselves. This is the case in the frog. It is found that a frog will live for a considerable time if its lungs are taken away, because the skin of the animal performs such a large share of the work which is common to lungs and skin alike. Even in our own case, we might be seriously injured, or even killed, if the skin were prevented from doing its duty. When Pope Leo X. ascended the Papal throne in Italy, a little child took part in the gorgeous procession which marked the occasion. He was made to represent the figure of the Golden Age, and to carry out this idea, his little body was covered over with gold-leaf. The result was, that owing to the complete blocking up of the pores of his skin and to the stoppage of the skin's work, the child died in about six hours.

Each sweat-gland we have seen to consist of

a little coiled-up tube, the end of which passes upwards to the surface of the skin and ends in a pore. The length of such a sweat-tube, if we suppose it to be pulled straight, is about one-quarter of an inch. In the palm of the hand there are about three thousand sweat-glands to each square inch of the surface. They are equally numerous in the soles of the feet, whilst in the neck and back there are not so many, their number in these regions being about four hundred to each square inch. Throughout the whole body, it has been estimated that the sweat-glands number between two and three millions. If, therefore, all the sweat-tubes from a man's body were to be unravelled and placed end to end to make a kind of rope, we should find that the total length would be ten or twelve miles; indeed, one celebrated scientific man calculated the total length of sweat-tubing in a human body to be from twenty-six to twenty-eight miles.

The care of the hair forms an important part of the care of the skin. There is a soldier's saying to the effect that 'where there is hair there is dirt.' This is very apt to be true, because hair is exactly the kind of substance in which dust collects, a fact which should be carefully borne in mind by people who work in a dusty atmosphere. You have only to look at the well-powdered head of the miller

in order to realise how much dust may adhere to our heads.

In so far as the care of the hair is concerned, it should be kept fairly short in men and boys. If we take a cold bath regularly, we should not wet the head in the bath; whilst if we swim or dive, we should take care that the hair is speedily and thoroughly dried. If we wet the head often, the natural oil which certain little glands in the skin throw out, to keep the skin supple and moist and to nourish the hair, is washed away. Baldness is very often found in people who are in the habit of constantly wetting the head. It is important, on the other hand, that the head should be thoroughly washed every fortnight or so, to get rid of any engrained particles which attach themselves to the 'scalp,' or skin covering the head.

It is not wise to use too much oil of any kind on the hair, but a little pure oil may be used as a dressing each morning. When the hair begins to fall out, it is needful to consult a doctor, because such a sign very often indicates a weak state of health.

People who do not attend to the cleanliness of their heads are liable to find certain little insects attaching themselves to the hairs. These parasites are not found in cleanly people, and are an evidence of the presence of dirt of

some kind. A little carbolic oil, which the chemist will supply, applied after washing the head thoroughly with soft soap and water, will destroy these insects, whilst the hair itself should be cut short.

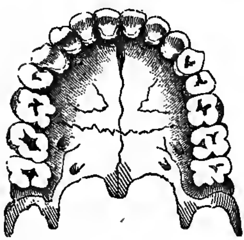
We are told in the Scriptures that 'the glory of a woman is her hair.' In the case of a girl's hair, it should be combed and brushed every night; and when the hair is dressed or put up, no great tightness should be used, because when tied too tightly, it becomes weak, and tends to fall out.

The teeth come next in order in respect of the attention which requires to be paid to our health. Very important organs indeed are the teeth. We should remember that the presence of a set of sound white teeth is itself a personal ornament, whilst when we have regard to the duties which the teeth perform, we soon see that they play an important part in the preservation of health.

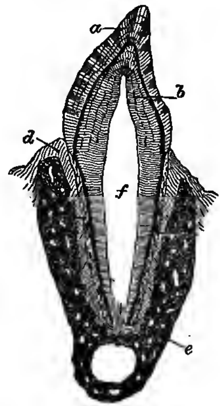
We have two sets of teeth, one after the other. The first set are called milk-teeth, and begin to appear at about the seventh month of a baby's life. This set numbers twenty. The whole of these disappear in due time, when the second set is developed. The second set begins to appear at about the seventh year of life, but is not completed as a rule until about the age of twenty or twenty-two, when the four

hindmost teeth in the jaws are developed, these being known as 'wisdom teeth.' The second set of teeth numbers thirty-two.

Each tooth is composed in the main of a substance called ivory, and not, as some people think, of bone. Ivory is the substance



The Second Set of Teeth in the Upper Jaw.



Vertical Section through a Tooth lodged in its Socket:
a, enamel; *b*, ivory; *d*, lining of the cavity in the gum; *e*, bony socket in gum; *f*, pulp cavity.

of which the handles of knives are often made, and is got from the tusks of the elephant and the walrus. Coating the top of each tooth is the hardest substance in the body, called enamel. The reason why the top of the tooth should be coated with this hard matter is because of the wear and tear to which it is exposed, so that the harder this part of the

tooth is, the less likelihood there is of its being quickly worn away.

The teeth may be attacked by a disease which we know as 'decay.' A decayed tooth sooner or later has not merely its enamel, but also its ivory, eaten away. Each tooth is hollow, and we find that the soft and delicate pulp in the inside of the tooth, a substance well supplied with nerves and blood-vessels, is exposed by the decay, and being irritated by the cold, gives us the pains and pangs of toothache.

The decay of the teeth can in most cases be prevented if we pay constant attention to their care. It is very surprising to find so many boys and girls allowed to grow up without being taught to clean their teeth regularly every morning and every night. You would not care to eat your food with dirty knives or forks, and you should be equally careful not to have dirty teeth.

That which makes the teeth decay is the presence of particles of food which are left between them. These particles are acted upon by certain germs which we breathe into the mouth from the air. The germs set up in the mouth a kind of fermentation (see page 40), and the result is that certain acids are produced, which eat away the substance of the teeth. It is clear, therefore, that if we

brush the teeth regularly, and thus get rid of the food particles left in the mouth, we remove the cause of tooth destruction.

The teeth should be brushed every morning on rising, and every night before retiring. The night brushing will remove the particles of food which have accumulated during the day. Use a hard brush and some simple powder, such as camphorated chalk. In addition to brushing the teeth across, brush them up and down also. If any decay appears in the teeth, we should at once go to the dentist, because a very great deal can be done by him to stop the decay and preserve a tooth from utter destruction.

Our eyes and ears are such important organs that the greatest possible care should be taken to preserve them from all stress, strain, and injury. This is all the more necessary in the case of the eyes, for the reason that when one eye is affected the other is also apt to suffer, because there is a kind of sympathy between the two. We should avoid all eye-strain, caused by some defect in the eye, which makes our eyes ache when we attempt to read print of ordinary size. When we find any difficulty in making the letters and words out clearly, this is a sign that we probably require spectacles to aid us in preserving our eyesight.

Many children suffer from eye-strain, and as a result of this they are troubled with headaches, which are produced by the constant attempt to make the eyes do work for which they are not fitted. Therefore in all cases of what we may call 'weariness' of the eyes we should seek the doctor's advice as to whether we require glasses or not. We should not attempt to read in a bad light, because eye-strain is thereby caused; nor should we fatigue the eyes by reading for too long periods at a time. It is a good thing for young people, after they have been reading, to practise looking at things far off, and thus accustom the eyes to be equally serviceable both for near sight and for far sight.

When anything gets into the eye, great pain may be caused, and sometimes an eye may be destroyed in this way. Do not rub the eye when anything gets into it, but pour in a few drops of salad-oil, and then place a pad over the eye, keeping it in position by a bandage. The oil will soothe the eye, and save pain till the doctor can come.

The ear is a more complicated organ than the eye. It consists of various parts. What we commonly call the ear is the least important part, being but the outer ear, which really serves as a kind of trumpet to catch the waves of sound. The opening into the ear is like a

street with only one way into it. It is a blind alley, and is closed at its inner end by what we call the 'drum' or 'drum-head.' This delicate structure is of great service in hearing, because it receives the waves of sound, and the tremors or vibrations caused by these waves are sent from the drum to the all-important 'inner ear,' which lies inside the head, in the bone called the 'temporal bone.' The inner ear, which is of a very complicated nature, is so acted upon by the waves of sound that the impressions it receives are carried to the brain, and there give rise to the sense of hearing.

We therefore really hear not with the ear itself, but with the brain; for it is only when the waves of sound act upon the inner ear, and the impressions thus made are carried to the brain, that we know what we are hearing, and can act upon the information we receive. Similarly, although the eye plays a most important part in the sense of sight, we see, not with the eye itself, but with the brain; we taste, not with the tongue, but with the brain; and so on.

Beware of putting anything into your ears. Children in joke put peas, cherry-stones, and the like into one another's ears. This is always dangerous, because sometimes doctors have found such things remaining in the ear for several years and causing deafness, the cause of the trouble not being known. Never

put the end of a pencil or anything sharp into your ear, because in that case you may make a little hole in the drum, when your hearing will be entirely lost until the hole heals up.

Sometimes children after scarlet fever or measles suffer from what we call 'running ears,' when a discharge appears, this discharge very often possessing a disagreeable odour. If any one's ears are like this, the patient should be taken to a doctor at once, because if the trouble is not cured, the drum of the ear may be entirely destroyed, and the power of hearing lost for ever. Be also very careful never to strike any one on the ears, or to box the ears, because a smart blow on the ear, in addition to being painful, is also dangerous, as it may break the 'drum.'

In the ruling of our lives in order that we may be healthy, there are several things to be attended to which are necessary for our health and happiness. We must take care that we do not work too long, and that we enjoy a certain amount of recreation or play. Too much play is, of course, just as great an evil as too much work. When we play we should take care that we have plenty of fresh air, and also a certain amount of exercise. We cannot be healthy unless we use our muscles, and thus cause ourselves to grow up strong and able to stand a certain amount of fatigue.

People who do not take sufficient exercise are apt to grow very weary after slight exertion. Gymnastic exercises and drill, which are carried out at school, develop the bones and muscles when these are growing. Games such as cricket, football, tennis, and the like, also develop the body in a healthy fashion. Exercise also does good, because it causes the lungs and the skin to do their work perfectly. The waste matters of the body are more easily got rid of, whilst we receive a full supply of the oxygen gas necessary for the maintenance of health. Exercise also tends to improve our appetite, and causes us to enjoy our food more thoroughly. When we enjoy our food and eat heartily, we can build up our bodies more perfectly.

Sleep may be described as a habit which is implanted in our nature. Whenever the work of the body has reached a certain point or degree, sleep becomes necessary. The proper period of sleep is, of course, during the night. The body then rests from its labours, and this rest fits it for the work of the day which is to come. A starving man will want less food if he sleeps or even rests in bed, because he lessens the work of his body.

Although sleep can thus to a certain degree replace food, we must remember that, on the other hand, no amount of food can replace

sleep. Those wonderful brain-cells of ours grow tired with the labour of the day, and our muscles become fatigued, whilst all the organs of the body also demand a certain period of rest. Unless, therefore, we sleep well and sleep soundly, we cannot expect to be healthy.

To enjoy sound sleep, we should go to bed feeling somewhat tired. We should sleep, as we have been taught in a previous lesson, in a pure atmosphere—that is, in a well-ventilated room. The room should be dark, and as far as possible it should be quiet. Noise is apt to render our sleep disturbed, even if we are not actually awakened by it. Young people require about ten hours' sleep, whilst older people feel satisfied with seven or eight hours.

It is curious to think that even the heart, which must work during sleep, as do the lungs, has its own little periods of rest between its beats. This fact alone shows us Nature's teaching—namely, that no organ or part of the body can go on working without rest. The same rule applies to the whole body itself. We have already been taught that if the air of the room in which we sleep is not pure, we cannot enjoy a good night's rest, because our brain-cells, instead of being supplied with a sufficient amount of oxygen

gas, are receiving carbonic acid gas, which in its way is a kind of poison to the cells.

Whilst in winter-time we should sleep in a bedroom with a sufficient degree of heat, it is well that we should avoid overheated rooms. It is better to cover ourselves with light and warm materials than to have heavy bed-clothes. This is the reason why heavy blankets do not form such excellent bed-clothes as lighter materials, such as eider-down quilts. We require to be warm during our sleep, but not to be overheated, or burdened with a great weight.

If it is necessary that our body clothes should be frequently changed, it is equally important to see that our bed-clothing is also kept clean, and changed when necessary. If any want of care is exhibited in this respect, the bedroom itself tends to become unhealthy and unclean. Bed-clothes may thus make the air impure, besides being apt to convey to us illness of various kinds.

The object of wearing clothes is to protect ourselves against sudden changes of temperature. It is a common idea that it is our clothing that gives us warmth. This is a great mistake. All the heat we enjoy is produced by the body itself as a result of the chemical burning in the system of certain kinds of food, of which fat, starch, and sugar are the chief examples.

The use of clothing is to preserve and to store for us this bodily heat. In winter we clothe ourselves heavily, and wear materials which are bad conductors of heat—that is, they do not allow the heat to pass through them readily, and thus to be given off to the air. On the other hand, in summer we wear lighter articles of clothing which are good conductors of heat, allowing the heat to pass through them freely, and therefore keeping us cool. In the case of the lower animals, we find their body coverings are, as a rule, bad conductors of heat. Hair and feathers are examples of such coverings.

We should always wear woollen clothing next the skin. Wool is a bad conductor of heat, and we keep our bodily temperature at the proper point because of this property of wool. Linen and cotton are good conductors of heat. When we wear them the warmth of the body is therefore conveyed away from it. Even in hot weather the wearing of light woollen garments next the skin is of importance, because the outer heat is not conducted to the body, and if free perspiration of the skin occurs, the woollen material will absorb the perspiration. Linen or cotton readily becomes saturated with the moisture, and in the act of drying may produce serious effects upon the skin, giving us chills and colds.

The colour of our clothing varies to a certain extent according to the season. White or light-coloured materials are preferred for summer, and darker materials for winter. It is found that colour has more effect upon the taking up of heat than upon conducting it. Experiments show us that while white-coloured stuffs absorb heat amounting to 100 degrees, dark-yellow absorb 140 degrees; dark-red, 165 degrees; light-blue, 198 degrees; and dark-blue and black, over 200 degrees. We therefore see that the lighter the tint of our clothing in summer, the less heat is absorbed from the outside; but the main point for us to remember is the difference between good conductors and bad conductors, the good conductors being of most service for our summer dress, and the bad conductors for our winter garments.

We have seen that a certain amount of exercise taken daily is necessary to preserve us in health. Boys and girls should attend carefully to the keeping of an erect carriage. They should not bend or stoop so as to render themselves round-shouldered. Not merely is it a deformity to have round shoulders, but the work of the lungs cannot be perfectly performed unless the shoulders are well braced back, and plenty of room given for the free play of our organs of breathing. One of the

effects of school drill is to cause the body to be well developed in this respect.

In the case of girls, they should be specially careful to avoid all compression of the chest. The habit of tight lacing is one that is condemned by all doctors. Not merely does it deform the chest, and thus prevent proper breathing, but if the lower part of the chest is compressed, we find other organs of the body put out of place. No girl can possibly be healthy if she is allowed to tight-lace herself. If we look at the natural shape of the body and of the skeleton, we see that the broadest part of the chest is really below. If, therefore, tight lacing is practised, the girl produces a deformity of the chest such as gives rise to a great deal of ill-health and disease.

Amongst personal habits one very important duty must be noticed. This is the duty of attending very strictly to the action of the bowels. No one can be healthy who does not attend to this part of his or her personal life. When the bowels do not act with regularity, people are said to suffer from constipation. Such a trouble is often the beginning of far more serious disease. Most commonly it arises from carelessness and want of attention to the demands of nature. The bowels should act at least once a day, and

the most natural time for such action to take place is in the morning. It is curious to notice how the influence of habit is seen here as in most other things. If we get into the habit of bowel action taking place each morning, such a habit will become established. Where constipation exists, a simple change in food may cure this condition. The eating of fruit, such as apples, oranges, and prunes, before or at meals, and the use of green vegetables, especially salads, are means which are very often effective in bringing about a cure of this trouble.

Any one who attends to the ordinary laws of health not merely enjoys a far greater measure of happiness than one who is ill, but shows this happiness in his or her appearance. The signs of good health are many. First there is a clear complexion. The tint of the skin is healthy, and can at once be distinguished from the excessive paleness which marks the presence of ill-health. The eyes are bright and sparkling, whilst the breath is sweet, owing to the fact that the teeth have been kept clean, and that food particles have been duly removed from the mouth by the cleaning of the teeth. The expression of the features is usually of a pleasing and happy description. It is when we are in pain or in ill-health that our faces clearly show that

something is wrong. It is impossible to suffer pain and to show at the same time a cheerful countenance.

Again, our work should be not a toil but a pleasure when we are healthy; in a state of perfect health we should be equally ready for work on the one hand, and for play and recreation on the other. In a word, good health means that we are in a condition to 'work while we work, and play while we play.'

CHAPTER VII.

EATING AND DRINKING.

We all know that in a certain time after we have eaten food and taken drink we grow hungry and thirsty again. If any one asked why it was that we wanted food or drink, the answer to this question might not be so easily found as we might suppose. To say that we eat and drink because we are hungry and thirsty is really no answer at all, because we should have to ask another question, namely, 'Why are we hungry and why are we thirsty?'

The real answer to these inquiries is to be found when we become aware of the actions and duties which the body is always performing. Whether we are asleep or awake, our

bodies are continually at work. In the day-time, when we are moving about, it is clear that the body is acting as a living machine, and this is true whether we do our work with our hands or our brains, or with both. Even when we are asleep the work of the body does not cease. We know that in sleep the heart, while its rate of beating is slower, is yet perpetually at work keeping the blood circulating through our bodies. Our chests still rise and fall in the act of breathing; and if we could look more deeply into the body, we should find that during our hours of rest, whilst there is less work being done than when we are awake, the body's labours do not actually cease.

Sleeping or waking, from the moment we are born till the moment we die, our bodies are machines that are constantly engaged in work. Now, all work, whether it is done in the living body or in a steam-engine, implies waste. This waste is the result of the work done, and we can see that if the living body went on working and wasting without rest or repair, a time would surely come when it could no longer discharge its duties. The waste has to be repaired, and the loss represented by the work done has to be made good. If this is the case, we can now answer the question 'Why do we need food?' Food represents

the material which the body needs in order that it may make good the waste which we have seen to be the result of the work it does. If the work of the body could be entirely stopped and no waste took place, we should not require food or drink at all.

The body may in one sense be compared to a fire which is always burning. In the case of the fire, it is coal which is consumed to produce heat. In the case of a candle, it is the wax which is consumed in the act of giving off light and heat. In the body, a kind of chemical burning is always going on. The fuel used is the food we eat. It is not consumed exactly in the same way as the coal of the fire or the wax of the candle is burned, but there are many points of likeness between the body on the one hand and the fire and the candle on the other. In both the fuel is consumed, and there is a certain likeness to be found in the kind of matter which is burned in the body and in the fire. There is another likeness to be discovered in the fact that the body, like the fire and the candle, gives off waste matter as the result of the burning. In the case of the fire, we have to put coals on when the fire burns low; and so with our body, we have to supply it with fresh food as its fuel, when it has used up what we have previously taken.

When we speak of the body 'burning,' we are apt to think that the kind of action which takes place is dry burning, as in the fire. In the body the burning might be better described as a wet burning, in which water plays an important part. We may find an illustration of wet burning in the heat produced when water is thrown upon quick-lime. The same thing happens when hay has been put in stacks while it is wet. Here, also, we find that heat is produced to such a degree that in some cases the farmer's stacks take fire. Keep in mind, therefore, that when we speak of our foods being consumed in our bodies by a burning process, we do not mean dry burning, such as is seen in the fire, but rather wet burning, like the action of the lime and the hay.

We may understand better the purposes which food serves in our frames if we compare the human body to an engine. We have first to build our engine, say, of iron; and having built it, we must supply it with coal and water in order that we may raise steam so as to make the engine do its work. Now, the stuff of which the engine is built is very different from that burnt in the furnace—namely, coal, which heats the water in the boiler and gives the machine working power.

The body may be compared exactly to the engine, because we find that the foods we require may be divided into two classes. The first class may be compared to the iron of the engine, because they go to build the body. The second class contains foods which represent the coal and the water. When they are consumed in our bodies they give us 'energy,' or the power of doing work. The first class of things we eat may therefore be called body-building foods. The second class may be called energy-producing or work-producing foods.

Other names have been given to these two classes of articles on which we feed. The body-building ones are often called 'nitrogenous' foods, whilst those that give us the power of doing work are named 'non-nitrogenous.' These names teach us that the first class of foods contain, amongst other things, an element called nitrogen, whilst this element is wanting in those foods that give us working power.

An engine will have consumed many times its own weight of coal and water when it has worked even for a very short time. In that time, however, it will not need any great amount of repair in the shape of new iron being added to it. Our bodies are again seen to be like the engine, because every day

we consume a far greater amount of the foods that give us working power than of those which build up and repair the actual waste of the body itself.

All the food we eat, sooner or later, is changed, when we digest it, into such a state that it can be added to the blood. The blood is the common fluid containing everything needed to build and repair the body, and also to supply our muscles and other parts with the power of doing their work. We thus see that the food, however unlike ourselves it may be before we eat it, must be really changed into ourselves and added to the body before it can be of any service to us.

The blood, which gives up its substance to nourish the body, and is therefore always having nourishment taken out of it, is repaired and renewed by our taking food, which, after it has been digested, is added to the blood. As the body is perpetually wasting in all its parts, so we find it is always being renewed by the blood sent to every portion of the frame. If the blood were not renewed by our taking food, the body would grow thinner, would cease to be properly nourished, and in the end we should die of starvation.

To show how the body is again like a fire, we find that a starved man really dies from loss of heat. His bodily fire has not been

replenished by fuel in the shape of food, and so his life comes to an end. The destination of food is the blood, and the blood is the one fluid from which all parts of the body draw the nourishment they need. If we do not get enough food, or if we take foods of an improper kind, such as do not nourish the body, we cannot expect to be healthy, or to be capable of doing our work properly.

Remember that two kinds of food are required for the support of the body—namely, food which will build the body, and food which, like the coal of the engine, when consumed in the body, will give it the power of doing work. In most cases the common foods we eat contain both kinds. Milk may be taken as an example of such a combination. If we give milk to a chemist, that he may analyse it and discover the things of which it is composed, he will tell us that it contains a large amount of water. He will show us that it also contains minerals, and the fat with which we are familiar in the shape of cream. It also contains a substance named casein, which is commonly called the 'curd' of milk. Last of all, the chemist would find in milk a certain amount of sugar, which he calls sugar of milk.

We see the cream or fat of milk rising to the top when milk newly drawn from the cow

is allowed to stand. If this cream, or fresh milk from which the cream has not been taken, is churned, we get butter, the churning having the effect of removing the fatty part or cream of the milk. If the milk is skimmed, so that the fat or cream is removed, we cannot, of course, expect to get butter from it. If, on the other hand, the milk is allowed to remain for a day or two it becomes sour, and if we apply heat to the soured milk we find it to split up into the curd, which appears as a whitish and stringy matter, and a watery and sweet part which we call whey. Whey is composed of the water, the minerals, and the sugar of milk; the curd contains the casein and the fat.

Milk is the food upon which the young of quadrupeds, as well as of man, are fed in the early part of their lives. The baby fed on milk grows and increases in weight. We learn from this that milk is a perfect food for the child. It must, therefore, contain both classes of foods—namely, those which build the body, and those which give the body the power of doing work. Now, the body-building part of milk is the curd or casein, whilst the fat and the sugar of milk represent those foods which may be compared with the coal and water of the engine, for they are the foods which supply the body with working power.

The minerals are also very important for building bones, and are used in other ways in the body, while the water of the milk is also required as an important food. We can understand the importance of water as a food when we remember what we learned in a previous lesson—namely, that two-thirds of the weight of the human body consists of water. The water is combined with the solid parts of the body, and also forms an important part of the blood, and of every other part of our frames. The water in the milk is therefore a very important thing, seeing that it supplies the body with something which is necessary not merely for building it up, but also for the carrying on of all its work.

We must also remember that water is always being formed in the body, and is being given off from the lungs, skin, and kidneys. If there is a drainage of water always taking place from the body, we know that we must obtain a fresh supply, and this is why we take water, not only by itself, but also in tea, coffee, and other beverages. As milk is the natural food for young children, they should not at first be fed upon other things. After the age of seven or eight months, this diet may be gradually extended by the addition of light milk puddings, bread and milk, rusks, and the like.

In order that we may know how to feed ourselves, we must learn something about the things that are contained in the various articles that we eat. If we eat meat of any kind, we obtain from the lean parts substances which, like the curd of milk, build our body. The fat of meat is like the butter of milk, in that it is a food that produces heat and gives us the power of doing work. The gristle and certain other things that we find in meat are not of such great importance as foods, but we can get from gristle and from bones when they are boiled a substance called gelatin, which to a certain extent is of use in the building of the body, but not so perfectly as the curd of milk or the juice of lean meat.

The potato is a very common article of food. In the potato we find a large amount of water; about three-quarters of its weight, indeed, is composed of water. The rest of the potato is made up of starch and minerals, along with a very small quantity of body-building stuff called gluten and a small quantity of fat.

Bread, which has been called 'the staff of life,' and is made from flour, contains a large quantity of starch, with gluten similar to that found in the potato. Bread also contains minerals, a small quantity of fat, and water. Cheese is a food very rich in fat.

It also contains curd (casein) obtained from the milk from which the cheese is made. Cheese is a very valuable food, but many people cannot take very much of it, because it is not easily digested. Suet pudding is mostly composed of fat and flour, the flour containing gluten similar to that in bread.

We must keep in mind that although starch and sugar do not seem to be like one another, they are in reality very much alike. If we take a piece of cooked potato into our mouth, and hold it there for some time so that it mixes with the water of the mouth, or saliva, as it is called, we soon become aware of a sweetish taste. This is because the saliva of the mouth contains a substance which turns starch into a sugar. We call this sugar grape-sugar, because it is more like the sugar found in grapes than the sugar we obtain from the sugar-cane. We are taught by this that the digestion of our food really begins in the mouth. Starch must be changed into sugar before it can be absorbed by the blood. This change takes place not merely in the mouth, for if any starch is not turned into sugar there it will be converted after the food leaves the stomach. On no account should food containing starch be given to a baby under the age of seven or eight months, for up to that time it is unable to digest

the starch, in other words, to turn it into sugar.

Not only does the body require the two kinds of foods already noted—namely, those that build the body, and those that are burned or consumed within it—but it requires them in certain proportions. We might live upon lean meat alone, or upon cheese alone, although we should require a very large amount of meat, but not so much of cheese, to support us. We should not, however, be healthy with such a diet, because neither of these foods contains the things we need in the proper quantities.

We usually take more than one kind of food at a meal, so as to get out of one food what the other lacks. For example, we add butter to bread, and thus supply the fat in which bread is deficient. Similarly, meat of any kind contains no starch, which is a valuable food; therefore we take potatoes or bread with meat, and so enjoy a better and more nourishing meal than if we took the bread, or potatoes, or meat alone. A rice-pudding may be made without eggs being added to it, but if eggs are mixed with the rice, the pudding is made more nourishing, because we have added not merely the white of the egg, which is a body-building food, but also the yolk, which largely consists of fat.

We have thus learned about the foods which are required to build and support our bodies,

and we have also learned that before food can be used in our body, it must be added to the blood through certain actions we call 'digestion.' Each kind of food carried by the blood is used by the body for its own purpose, either to build up the body and to repair its waste, or to be consumed by the burning process we have spoken of, and so to give us our power of doing work. Under certain circumstances, the curd of milk and the like substances may also be burned so as to give us working power. The true use of such substances as the curd of milk, the lean of meat, and the gluten of flour, however, is really to build up the body; whilst it is the fats, starches, and sugars that really represent the coal of the human engine.

That we may be well and keep well, it is necessary that we should eat neither too much nor too little food. If we eat too much, the stomach is apt to become disordered, and the excess food which has to be got rid of disturbs the body at large. Even if we take too large quantities of particular foods, we may make ourselves ill. In taking too much food, it is as if we were overloading the engine fire with more fuel than it requires to do its work. Besides, the blood, being overcharged with food it does not need, cannot nourish the body properly. Too large amounts of food in

the blood really act as a kind of poison to the body.

We have already seen that water is the most important food we take, because our bodies are composed of so much of this fluid. A proof of this is seen when we remember that a man, as you were told in a previous lesson, is capable of living on water alone for a long time, varying from thirty to forty days. At the end of that time he will probably die of starvation, because the water and the oxygen he breathes in from the air, which has also to be taken into account, will not supply him with all the body needs. It is a very wonderful thing, however, to think that water by itself will keep us alive for so long a time.

We must also remember that the minerals contained in our food are of great importance to us. A mineral needed in order that the stomach may do its work properly is common salt. It is also needed for other purposes in the body, such as helping to remove the waste; and it is found in every fluid the body makes. We can discover it in the tears that wash the eyes. It exists in the blood, and it is also found in the perspiration or sweat given off from the skin.

Among other minerals we require to keep the body in health, iron may be mentioned. This iron helps to form the colouring matter

of the blood, which is contained in the little red corpuscles that float in the blood and give to that fluid its red hue. If these red corpuscles do not get sufficient iron, illness results. In the same way, another mineral, potash, is necessary to preserve us in health. This potash is found in the blood, and also in various parts of our frames. If we do not get sufficient potash in our food we become afflicted with a disease known as scurvy. This disease is cured by our taking foods such as fresh meat, milk, potatoes, and green vegetables, all of which contain potash.

CHAPTER VIII.

TEA, COFFEE, COCOA, AND ALCOHOL.

We have seen how necessary water is for the support of the body. One of the chief reasons why we require every day a large quantity of water, you will remember, is that two-thirds of the weight of the body consists of this fluid; and it is required, besides, in all our bodily actions. We drink other beverages besides water, such as those made from tea, coffee, cocoa, and chocolate. Tea, as you know, consists of the dried leaves of the tea-plant, coffee of the ground beans of the coffee-plant, while cocoa, and the chocolate which is

made from it, is the product of a plant known as the cacao-tree.

There is a wide difference to be noted between tea and coffee on the one hand, and cocoa and chocolate on the other. If we ask a chemist to analyse cocoa for us, he will tell us that it contains a certain amount of gluten, which we have seen is found in flour, and corresponds in its nature to the curd of milk. It is a body-building food. In cocoa he will also find starch and a large amount of fat, together with some minerals. In tea and coffee we do not find these things, or at least, if they exist, they are present in such small quantities as to be practically useless for nourishing the body. Tea and coffee are not, therefore, foods in the true sense of that word, because they do not add anything to the substance of the body, nor do they supply us with working power; whereas, on the other hand, cocoa, containing fat, starch, and gluten, must be considered to be a true food.

If people with not too much money to spend on food would drink cocoa instead of tea, they would be stronger and healthier. A very great number of people drink tea and coffee, believing that their bodies are nourished by these beverages. This is a great mistake. Tea and coffee are useful under certain circumstances because they contain substances which

stimulate us. When we are tired, and take tea or coffee, we feel refreshed, because the substances contained in them stimulate our nervous system, and through the nervous system the body is thus made to work more quickly and easily.

At the same time, we can see that if we were only to stimulate our bodies by taking tea and coffee, and not supply them with true foods, we should be acting as foolishly as if we flogged over-tired horses. The weary animals require rest and food, and to whip or spur them to make them continue working would be foolish and cruel, because they would be much worse after they had been whipped and compelled to work than they were before. Tea and coffee are of service in stimulating a body which is well fed and well nourished, because, in addition to helping us to do our work more efficiently, they also seem to have the power of making the food go a little further in the nourishment of the body and in the performance of the body's work.

In order that we may get the most good out of the tea we drink, we must remember that if tea stands long in the pot, the boiling water will take out of the leaves certain substances which it is not good for us to drink. Tea which has stood long, we all know, has a very bitter taste. If such tea is allowed to

settle in a cup, a white substance appears in the bottom of the cup when it gets cold. It is this substance, called tannin, which causes the bitter taste, and it is very much the same kind of thing which is got from the bark of trees used in tanning leather.

'Stewed' tea is therefore very bad for us, because it not only prevents the digestion of proper foods, but may itself upset the stomach and cause illness. Tea should be taken only when freshly made. The water used in making it should be boiling, but should have just come to the boil. We should place in the teapot a strainer into which the tea-leaves are put, and this should be removed, together with the leaves, a few minutes after the tea is infused, and before it is drunk. By taking the tea-leaves out of the pot with the strainer, we cannot possibly have the strong and bitter tea which is so bad for us. If it is foolish for people to expect they can live upon food which consists of tea and bread-and-butter, and if they make themselves weak by trying to live on such things, they will make themselves much worse when the tea they drink is allowed to 'stew,' so as to take out of it the injurious substances we have described.

Tea and coffee, we have seen, stimulate the nervous system and whip up the body, as it

were, to enable it to perform its work more quickly. It is wrong to take tea and coffee with meat foods, because we know that these drinks either slow down, or may actually stop for a while, the digestion of food in the stomach. When people take what they call a 'meat tea' or 'high tea,' and thus eat meat and drink tea along with it, they are very apt to suffer from indigestion. Also, we should not take tea or coffee late at night, because they are apt to keep us awake; or if we do fall asleep, they may cause our sleep to be disturbed by dreams or nightmare.

Besides taking tea and coffee as drinks, many persons take beer, porter, or various kinds of wines or spirits. Among the wines drunk are claret and port; the spirits most commonly consumed are whisky and brandy. Now, in all these drinks we find a certain substance termed 'alcohol,' which might also be called spirits of wine. Some of these drinks, such as spirits, are stronger than others, because they contain a larger quantity of this alcohol. This is the substance which in all of these drinks, if taken in too great a quantity, causes people to become drunk. The alcohol acts as a stimulant to the brain and nervous system when taken in small quantity; but if a person drinks much beer, wine, or whisky, he loses the power

of thinking properly. He is unable to walk steadily, and sooner or later he passes into a state of sleep.

Alcohol, let us remember, is produced by an action we call fermentation. To make alcohol we require yeast, which we saw to consist of very minute plants. Each yeast plant is a little round body termed a cell. The baker uses yeast because, when fermentation occurs, carbonic acid gas is produced, and this gas 'raises' or lightens the dough from which the bread is made. The brewer uses yeast in order to produce fermentation, so that the beer he makes will contain alcohol. Alcohol and carbonic acid gas are, therefore, two things which the yeast plants are able to produce when they are added to any substance containing sugar. The baker does not want alcohol; he wishes the carbonic acid gas to lighten the dough. The brewer does not want the carbonic acid gas; he wishes to get the alcohol for his beer. We see that what one man wants the other does not require.

All these substances, from beer, which contains little alcohol, to whisky or brandy, which contain much alcohol, are not foods. They may to a certain extent burn in the body, but they burn so quickly that to use them as foods would be a very wasteful thing to do. If we put coals and sticks in a fire, the fire

burns slowly and gives off a large amount of heat. Suppose we fed our fire with straw instead of coal, we know we should get heat; but the straw would burn so quickly that we should have to be always heaping fresh straw on the fire, and we should be getting also less heat than from the coal. The straw would also be much more expensive in the long-run than coal. If we compare our body with the grate, our ordinary and true foods will be like the coal; but if we took beer, wine, or whisky as foods, they might burn in the body, but they would resemble the straw, and be consumed so quickly that we should find it very expensive to use them.

People take beer and other drinks containing alcohol because they like the taste of the various fluids which contain this substance. It is not necessary for any healthy person to take alcohol at all. It may act like tea and coffee when taken in small quantities, and therefore whip up the body, enabling it to do its work more quickly. If alcohol is taken in any great quantity, its effect is really to tire out the body sooner than if nothing had been taken at all. In small quantity, alcohol may therefore do little harm; but we may be quite sure about this, that alcohol is not at all necessary for healthy people, and it cannot be said to do them any real good.

Children should never take any alcohol, as it stops the growth of the body, and acts very injuriously in other ways. They should drink water or milk, which are really much better for them than even tea and coffee.

People who take too much alcohol, we have seen, get drunk. The more alcohol there is in any drink, the less of it will be required to make a person drunk. A man might drink a large quantity of beer without getting drunk, but he would feel tired, heavy, and sleepy, while his face would be flushed and reddened, and he would not be able to think clearly and to do his work properly. If people who are accustomed to drink beer and other fluids containing alcohol do not get drunk, this is because their bodies have become accustomed to the taking of alcohol; but it is none the less true that they are doing themselves a great deal of harm, and that they are laying themselves open to the attack of disease. If people who take beer, wine, or whisky because they feel tired, would rest and take food, or drink tea or coffee, they would be much better.

When people are not well it may be different, for they may then require a small quantity of wine or other fluid containing alcohol as a kind of medicine to stimulate the body. But this should only be taken by the

doctor's orders. When people begin to take anything containing alcohol, they are apt to get a liking for drink of this kind, and in many cases are unable to stop the use of such beverages. We know that very many persons become drunkards because they are unable to stop taking alcohol. Doctors would tell you of many diseases which people who take much drink are liable to suffer from. Those who drink much beer, wine, or whisky are not merely likely to die before their time, but are also not able to do their work properly. In this way a great deal of misery is caused in the world by men who drink alcohol. For if they are unable to do their work they lose their employment, and if they cannot earn money their wives and children must become very poor, and suffer a great deal from want of food and of other things we all require to make us healthy and happy.

Tobacco is the leaf of the tobacco-plant, and it is most commonly used for smoking. People smoke it in pipes, or use it in the shape of cigars or cigarettes. Powdered tobacco is known as snuff, and some people sniff this substance up the nostrils. Some men are given to chewing tobacco. People smoke tobacco chiefly because it gives them a certain sense of restfulness. It is what we might call a soother to the body. Those

who take snuff do so because of the pleasant sensation it produces in the nose. Snuff-takers are apt to suffer from troubles which affect the nose, and in many cases their voices are also affected, so that they cannot speak clearly.

Children should never smoke. Tobacco, if not smoked in too great a quantity, may have no ill effects upon grown-up men, but it has a very evil effect on the bodies of young people. It tends to check their growth, because of its effects on the blood. There are, therefore, two things that children should on no account taste or use. One is alcohol, and the other is tobacco. A boy who smokes cigarettes is certain to injure his health, because of the action of the tobacco on his blood. Tobacco destroys the appetite, and he will not eat the proper quantity of food he requires to build up his body.

Boys who smoke do so because they think it is a manly thing to imitate older people. They are very much mistaken in thinking that any one who sees them will consider them more manly. They should remember, above all things else, that if they smoke before they are grown up they are certain to do themselves a very great deal of harm. Boys who do not smoke may not feel that they require or like tobacco when they grow up to

be men. If they do not smoke then, they will save a good deal of money, because smoking is an expensive habit.

CHAPTER IX.

WHAT TO DO IN ACCIDENTS AND ILLNESS.

We are all liable to suffer from illness, and we may at any time meet with an accident which will cause us great pain, or may even end in death. When any one is ill, or meets with an accident, the doctor should be sent for at once, because he knows exactly what should be done that the patient may be restored to health. Sometimes, however, the doctor is far away, and it is therefore very important for us to know what to do to relieve pain and to help the sufferer until he arrives.

We ought all to be taught some simple rules which we could easily follow as to the best way of giving assistance to those who are in distress. This is why grown-up men and women attend what are called 'Ambulance Classes,' or classes in which they are taught how to give 'First Aid' to people who meet with accidents, or are attacked by sudden illness. Such assistance is well called 'First Aid,' because it is intended only as a temporary measure until the presence of the doctor

can be secured. We can do a very great deal indeed to save people pain by knowing exactly what to do in various kinds of accidents, and we must also know how to avoid doing improper things. It is as important for us in such cases to know what not to do, as to know what to do.

Let us begin by seeing what can be done when a person has a 'fit.' Notice first that there are different kinds of fits, and that the measures which relieve a person suffering from one kind are quite different from those needed in another case. The commonest of all fits is what we call a fainting fit. We are apt to faint when we remain too long in a very heated room where there is much foul air. We may also faint from receiving bad news, or from suffering any kind of shock. In a fainting fit the person becomes insensible. He falls to the ground and lies quite still. If you look at his face, you will find it very pale, and his lips will also be bloodless. His eyes will be shut, and if you feel his skin it will be cold.

When a person shows these signs, you must first loosen everything about his neck and chest, remove his collar and tie, and unbutton his waistcoat so as to give free play to his chest that he may breathe properly. See that he is carried into some place where the air is pure, and prevent people from

crowding about him. Keep his head low, and remember that it is always well to do this when the face is pale. By keeping the head low, we assist the blood to return to the brain, for when the brain gets its proper supply of blood once more, the person will wake out of his insensibility. If you have smelling-salts, apply them to the patient's nose, but see that the salts are not too strong. Sometimes people burn feathers, and allow the smell of the burning feathers to pass up the nostrils. In a few minutes the patient will probably recover, but it is well not to allow him to sit up until he has rested in the flat position for a while.

Another kind of fit is called an epileptic fit, or a convulsive fit. Here the person very often falls down with a sudden cry, and while on the ground tosses his body about. His face is pale and his mouth froths, and if you see a little blood coming from the mouth you will know that he has bitten his tongue. This is a fit which sets all the muscles of the body into 'convulsions.' The person is insensible, and if you look at his hands you will see that the muscles have drawn the thumbs right into the palm of the hand.

Here again you must remove all clothing from the neck and chest. Put the patient on a rug or mattress on the floor, because if you

put him on a bed or sofa, it is likely he will throw himself off and hurt himself. All you can do is to restrain his movements by grasping the arms by the wrists, and the legs by the ankles. You must not attempt to stop his movements, because you cannot do this, and if you used much force you might hurt him. He will soon cease struggling and will open his eyes, but will be in a dazed or stupid state. You must watch him carefully afterwards, because he may take another fit, and if he is left to himself, and no person is beside him, he may injure himself.

A third kind of fit is that known as apoplexy. The person falls senseless in this case, and his face, instead of being pale, is very red. There are no convulsions. If you listen to his breathing, you will find that it is of a noisy or snoring character. What has happened is that something has gone wrong with the brain. You must put the patient to bed in a dark room; take off his clothes, keep the head high, and apply cloths moistened with cold water and vinegar to the head. The doctor should be sent for at once.

If we prick a finger with even a very fine needle, we draw blood. Now, this blood is contained within very fine tubes, and so fine are the smallest of them that although the point of a needle is a very minute thing, it

will tear or wound a large number of them. The blood everywhere in our body is contained within such tubes, which are called 'blood-vessels.' When, therefore, we cut our finger,

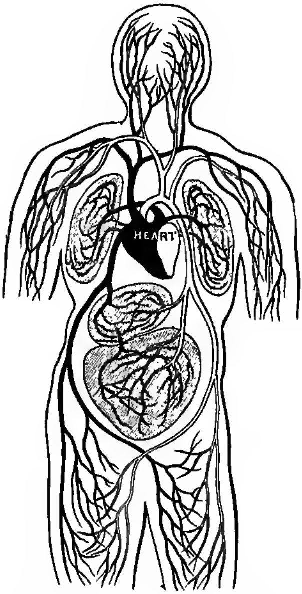


Diagram of the Circulation.

The arteries (which carry blood from the heart) are shown white; the veins (which carry blood to the heart) are shown black.

or when any part of the body is wounded, we see that we must have divided some of these tubes in which the blood is carried through the body. If it is a small cut we

can easily stop the bleeding, but it may be difficult to do this if the cut is a big one, and if we have wounded a large blood-vessel. It is necessary to stop the bleeding quickly, because if much blood is allowed to escape from the body it causes great weakness, and if a very large quantity of blood is lost the person may die.

Pure blood is always being pumped from the left side of the heart to nourish the body. When this blood has been sent through the frame, it returns again to the right side of the heart. The blood coming back to the heart is impure, because it has gathered from all parts of the body waste matter, which, as we saw in a previous lesson, is got rid of chiefly by the lungs. The colour of pure blood going from the heart to the body is bright-red, while that of impure blood coming from the body back to the heart is dark-purple. You must keep in mind this difference, because if we wound a blood-vessel which is carrying pure blood from the heart to the body, we can tell that such an accident has happened by the bright-red colour of the blood which flows from the wound. In such a case an artery has been cut—that is, a blood-vessel carrying blood from the heart to the body. On the other hand, if the blood is dark-purple in colour, we know that we have wounded a vein—that is, a blood-

vessel returning the impure blood to the heart that it may be sent to the lungs.

As a rule, veins lie nearer the surface than arteries. You will see how the blood flows in the body if you tie a piece of string round your wrist with moderate tightness, and allow your hand to hang downward. The veins in the back of the hand will swell, and you will notice that they swell *below* the string, and not above it. You learn, therefore, that the string has stopped the flow of blood *coming up* the arm in the veins, but has not interfered with the flow of the deeper-seated arteries. To do this, the string would have to be tied as tightly as possible.

As pure blood is coming from the heart to the body, we see that when an artery is wounded we must tie a bandage tightly *between the wound and the heart.* If, on the other hand, it is a vein that is wounded, we must tie a bandage either on the wound itself, or, if that is not sufficient to stop the flow of blood, a bandage must be tied on the side of the cut farthest from the heart as well.

Artery wounds are always dangerous, because the heart is like a pump which is driving blood through these blood-vessels. You will know when an artery is wounded, not merely by the bright-red colour of the blood, but by the fact that it comes from the

wound in jets, each jet being caused by a stroke of the heart. If it is a vein that is wounded, in addition to the blood being of a dark-purple colour, it will simply flow from the cut, and will not spurt as in the case of an artery.

In the case of a simple cut, which severs only very small blood-vessels, you must cleanse the cut thoroughly. Wash it well with tepid water, and if possible add a few drops of carbolic acid to the water, because the acid will tend to cleanse the wound more thoroughly than the plain water. It is most important in all cuts and wounds to see that no dirt is left in them. If dirt is left in a cut, the wound will not heal quickly, and 'matter,' which is a yellowish fluid, will form in it.

To bind up a wound, use a piece of lint or linen rag, having first made sure that it is thoroughly clean. Place it on the wound, and then tie a handkerchief or other bandage round it, both to keep the rag in position, and to apply pressure to the wound in order to stop the bleeding. When the bleeding stops, as it will do if you have applied the bandage properly, bring the edges of the wound together with strips of sticking-plaster. Over these put your pad of clean lint or rag, and then your bandage.

If the bleeding comes from an artery, you

must at once press your fingers on the wound, or between the wound and the heart and near to the injury. In this way you can stop the spurting of the blood at once and save the injured person from losing blood. You should then get some one else to tie a handkerchief or

other bandage tightly over a pad between the wound and the heart, but as near to the wound as possible. If this does not stop the bleeding, take a piece of stick, pass it through the looped end of the bandage or handkerchief, and begin to turn the stick so as to twist the bandage. In this way you will be able to

tighten the bandage so as to stop the flow of blood till the doctor arrives and takes means to prevent any further bleeding.

When a vein is wounded, and you see dark-purple blood oozing from the cut, put a pad of clean lint on the cut, and tie a bandage over it. If this fails to stop the bleeding, put another bandage on the side of the wound away from the heart.

In a simple scratch of the finger we do not need to pay much attention to the stopping of the blood, for the bleeding soon ceases of itself. This is because the blood clots and forms a kind of plug which closes up the wounded blood-vessels. Do not disturb this clot, because it is not merely Nature's way of stopping the bleeding, but it also seems to supply material which aids in healing the cut itself. Never allow any one to apply cobwebs to a cut to stop bleeding. They are full of dirt and germs, and have often caused blood-poisoning.

Sometimes people suffer from bleeding at the nose, or they may bring up blood from the stomach or lungs. When a person's nose bleeds, you must prevent him from hanging his head over a basin. He should be made to lie down with the head slightly raised, and the clothes should be loosened about the neck. With your fingers you may press the root of

the nose; and it is helpful to apply to the nape of the neck a sponge wrung out of cold water. If the bleeding is very severe, you may put little plugs of cotton-wool in each nostril, and send for the doctor.

Delicate people may bring up blood from the lungs or the stomach. If the blood comes from the stomach, you will know this because it will be dark-coloured, and will usually be clotted. If the blood comes from the lungs, the colour will be bright-red, and it will be mixed with froth, because of the air which it contains. A person suffering from bleeding from the lungs or stomach should be put to bed in a cool room. His head and shoulders should be raised on a pillow, and he should be given little bits of ice to suck. If ice cannot be got, give him sips of cold water, and you may put a little vinegar in the water, as this will assist in stopping the bleeding.

You have been told how important a thing it is to see that every wound is cleansed, so that no dirt be allowed to remain in it. You were also told that when dirt remains in a wound it sets up irritation, and there is produced a yellowish, thick fluid, which is known as 'matter.' Suppose you prick your finger with a dirty needle, and do not suck the wound and thus cleanse it, in a few hours the finger will begin to feel painful. It will throb

and become very hot, and soon afterwards, on looking at the finger, you will see matter forming beneath the skin. This is what people call a festering or gathering finger. If matter forms in a large cut, it may be very dangerous, because the matter, which is injurious, may be carried to other parts of the body and set up disease.

The doctor often gets rid of the matter by lancing the finger. When matter has formed, it is a good plan to apply hot poultices of bread and water to the part, because the heat of the poultice, which must be constantly renewed, assists the formation of the matter, and thus brings the injury sooner to a head, so that when it is lanced all the matter can be taken away. After the matter has been removed, the poulticing may be continued for a little, in order that it may clean the wound. After that, when the wound is in a healthy condition, it should be treated simply as an ordinary cut.

When a person is stung by a wasp or bee, you should remove the little black sting you will find sticking in the wound. Get a little weak ammonia and apply it to the sting, or take the blue-bag from the kitchen, and apply a little of the blue. The application of oil will ease the pain. The juice of a raw onion cut in halves is another old-fashioned remedy.

Remember if an insect stings any one in the mouth to send for the doctor at once, as the mouth will swell, and the person may be suffocated.

In the case of a snake-bite, tie a tight bandage between the bite and the rest of the body, to keep the poison from spreading. If you have no sore in the mouth, you can suck the wound and spit out your saliva. Do the same things if a dog bites any one, and see that the dog is kept chained up until you know whether it is mad or not.

If you have reason to suppose that a person has broken a bone, be very careful that the broken part is not treated roughly in any way, but is very carefully bandaged up and all movement of the part prevented. A broken arm should be carefully put up in a sling. You can see that if the bones of a man's leg are broken, and you attempt to raise him up and set him on his feet, you may make his accident very much worse, because the broken ends of the bone may be forced through the skin. In the case of a broken leg, the person should be carried very carefully into the nearest shelter, and laid on a mattress to await the arrival of the doctor. If the patient has to be carried any distance, you must bandage sticks or umbrellas on each side of the broken leg, so as to keep it from being

moved. You must then tie the leg which is broken to the sound leg, because the sound leg in such a case acts as a support to the one which is broken.

If we receive a blow, it is apt to leave marks on the skin. A person who has been hit on the eye, for example, soon develops what we call a 'black eye.' The blackness is produced by the blood which has escaped from the fine blood-vessels under the skin. It takes a long time for this blood to be absorbed or carried away. The bruise will not be cured for some time, and we see the gradual changes of colour in the bruise, showing how very slowly the blood is removed from the part. It is helpful in the case of bruising to apply cold to the part, and the sooner this is done the better. Cloths steeped in cold water mixed with vinegar should be kept constantly on the bruise. You may cover these cloths with a little piece of oiled silk, which will prevent the water from drying too rapidly. For a black eye or other kind of bruise, many people cut a little bit of meat off a joint or steak and place this upon it. The meat is cold and soft, and can be used instead of the cold water.

If we miss our footstep in coming downstairs, or if we step on a slide, and our foot doubles under us, we are apt to suffer

from what is called sprain. Sometimes even a bone may be broken through such an accident; but if it is merely a sprain, what we have done in such a case is to strain very severely the stout cords, called ligaments, which bind the bones together at the joints. A sprain may be a very painful accident indeed. The part which is affected swells up, and it may be impossible to move the joint at all without experiencing great suffering. When a sprain has occurred, the best thing to do is to put the part into water as hot as can be borne, and to allow it to remain there for a long time, renewing the water so as to keep up the heat. It is then helpful to bandage the part.

Remember that in all sprains it is very necessary that the part should be kept quite at rest and no movement permitted. When the swelling has been somewhat reduced, you may rub the place gently with oil, or use a fluid which the chemist will supply you with, and which is called a liniment or embrocation. Sprains often take a long time to get better. When this is the case, it may be helpful once or twice a day to run cold water on the part for a minute, and then to run hot water upon it, using the hot and cold water in this way, time about, for a few minutes at a time.

In the case of a burn or a scald, apply oil,

such as salad-oil, linseed-oil, or castor-oil, at once on lint, and keep the air away from the injury. If any clothing remains on the burn, do not tear it off, but soak the burnt part in tepid water, and thus loosen the clothing. The best thing for a burn is Carron oil, made of equal parts of linseed-oil and lime-water. Apply this on strips of lint, and cover all over with cotton-wool and a bandage. When a person's clothes catch fire, place him on the floor and cover him with the hearthrug or anything else handy, so as to put out the flames. If he rushes about, the flames will only burn the faster.

The things you have just been told are to help you to give assistance to people who are in sudden distress. You can do much by such aid to lessen pain and to get the person who has been injured out of danger. Remember that in any serious case some one should go for the doctor, while you are doing your best to give what assistance you can. All you can do is to treat the injured person 'till the doctor comes.' It would be well if people would send for the doctor more frequently, and also sooner than they do.

There are many signs of illness which should teach us that the doctor ought to be asked to come as quickly as possible. If a child has a sore throat, and is very hot and feverish, it is

possible he may be suffering from a fever, and in such a case the only wise thing to do is to get the doctor at once. If the child has a rash on his body, this points to fever even more clearly, and in that case it would be well to put him to bed at once and to keep him away from other children, so as to avoid infecting them; the doctor will do whatever else is necessary.

If a child has a nasty cough, with a whoop, he may have whooping-cough, and he should be kept in a room by himself until the doctor sees him. A bad cough with a pain in the chest, or a severe pain in the stomach, may be the beginning of a serious illness, therefore the doctor should be asked to see the patient at once. If only people would get the doctor to see those who are ill as soon as the signs of illness appear, patients would be spared much pain and many lives would be saved; for illnesses which could have been successfully treated by him in their first stages, may have grown quite beyond his power when there has been delay in sending for him.

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